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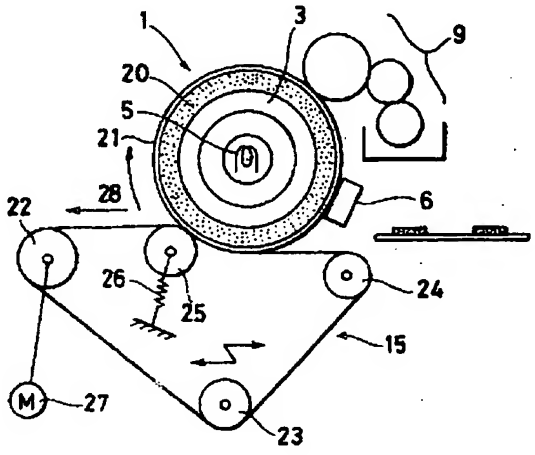
(54)【発明の名称】　定着装置

(57)【要約】

【目的】　剥離時における画像損傷の問題点を解決する定着装置を提供する。

【構成】　転写材上の未定着トナー像を定着する熱定着ロール型定着装置において、0.5mm 以上の弾性体（２０、２１）が被覆された熱定着ロール（１）と、複数の支持ロール（２２、２３、２４）によって張架された耐熱ベルト（１５）とを設け、該耐熱ベルトと前記定着ロールとの間にニップを形成するよう耐熱ベルトを定着ロールの廻りに所定角度だけ巻付け、前記ニップの出口において前記耐熱ベルト内側に圧力ロール（２５）を配設し、該圧力ロールを前記耐熱ベルトを介して前記熱定着ロールに圧接することにより、前記熱定着ロールの弾性体に歪みを生じさせることを特徴とする。前記熱定着ロール（１）の弾性体（２０、２１）の円周方向の歪み量εは0.５％以上であってもよい。熱定着ロールを駆動し耐熱ベルトを従動としてもよい。また耐熱ベルトの静摩擦係数を0.40以下としてもよい。さらに熱定着ロールに塗布する離型剤としてアミノ変性シリコンオイルを使用してもよい。



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【特許請求の範囲】

【請求項１】　転写材上の未定着トナー像を定着する熱定着ロール型定着装置において、0.5mm 以上の弾性体が被覆された熱定着ロールと、複数の支持ロールによって張架された耐熱ベルトとを設け、該耐熱ベルトと前記定着ロールとの間にニップを形成するよう耐熱ベルトを定着ロールの廻りに所定角度だけ巻付け、前記ニップの出口において前記耐熱ベルト内側に圧力ロールを配設し、該圧力ロールを前記耐熱ベルトを介して前記熱定着ロールに圧接することにより、前記熱定着ロールの弾性体に歪みを生じさせることを特徴とする定着装置。

【請求項２】　前記熱定着ロールの弾性体の円周方向の歪み量εは以下の関係式を満足することを特徴とする請求項１記載の定着装置。

ε≧0.5％

【請求項３】　前記耐熱ベルトは少なくとも３つ以上の支持ロールにより張架され、該支持ロールの一つは変位ロールで他の支持ロールは固定ロールで構成され、該変位ロールは中心軸の位置を他の固定ロールの中心軸と交差するように移動できるよう構成されたことを特徴とする請求項１記載の定着装置。

【請求項４】　前記変位ロールの中心軸は、前記耐熱ベルトの回転方向に対して該変位ロールに最も近い上流側と下流側に位置する２つの前記固定ロールの中心軸を焦点とする楕円軌跡に沿って変位することを特徴とする請求項３記載の定着装置。

【請求項５】　前記熱定着ロールは２つの固定ロールの間において張架された耐熱ベルトとニップを形成することを特徴とする請求項３記載の定着装置。

【請求項６】　前記熱定着ロールと耐熱ベルトとのニップ領域の前記圧力ロールの上流側において、耐熱ベルト内側から該耐熱ベルトを介して熱定着ロールに圧接する弾性体ロールを設けたことを特徴とする請求項１記載の定着装置。

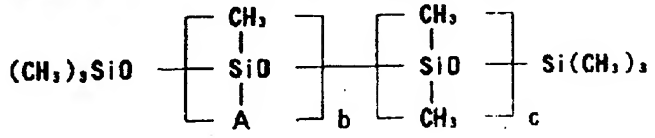
【請求項７】　前記熱定着ロールと、複数の支持ロールによって張架された耐熱ベルトとを圧接させてニップを形成し、該ニップ領域において定着を行う定着装置において、前記ニップ領域の耐熱ベルト内側に熱定着ロールの表面温度を検出する温度センサが配設されていることを特徴とする定着装置。

【請求項８】　転写材上の未定着トナー像を定着する熱定着ロール型定着装置において、0.5mm 以上の弾性体が被覆された熱定着ロールと、複数の支持ロールによって張架された耐熱エンドレスベルトとを設け、該エンドレスベルトと前記定着ロールとの間にニップを形成するようエンドレスベルトを定着ロールの廻りに所定角度だけ巻付け、前記ニップの出口において前記エンドレスベルト内側に圧力ロールを配設し、該圧力ロールを前記ベルトを介して前記熱定着ロールに圧接することにより、前記熱定着ロールの弾性体に歪みを生じさせるようにし、前記定着ロールを駆動し、エンドレスベルトを従動としたことを特徴とする定着装置。

【請求項９】　前記耐熱エンドレスベルトの静摩擦係数が0.４以下であることを特徴とする請求項８記載の定着装置。

【請求項１０】　前記定着ロールに、次の一般式（１）で表されかつ25℃における粘度が10～100,000cs のアミノ変成オイルで成る離型材を塗布したことを特徴とする請求項８記載の定着装置。

【数１】



（１）

〔但し、式中、Aは－R′－X（ここで、R′は炭素数１～８のアルキレン基を示し、Xは－NH_2 または－$NH(CH_2)_2NH_2$ を示す）で表され、b およびc はそれぞれ０＜b ≦10、及び10≦c ≦1000である〕

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、複写機、プリンター、ファクシミリ等の画像情報記録装置において、記録紙上の未定着トナー像を接触加熱定着するいわゆる加熱ロール型定着装置、とりわけ加熱ロールとベルト圧接装置とから成るベルトニップ方式定着装置にに関するものである。

【０００２】

【従来の技術】従来の定着装置としては、図１に示すように、一対の加熱されたロール間の圧接領域に未定着トナー像を通過させることにより定着を行ういわゆる加熱加圧ロール型定着装置が多用されている（以下これをロールニップ方式と言う）。図１において、１は定着ロール、２は加圧ロールである。定着ロール１は、アルミニウム等の熱伝導率の高い金属の中空ロール３の表面に耐熱性と離型性を有するテフロン（デュポン社の商標）の被覆層４が形成されたものであり、中空ロール３の内部には加熱源としてハロゲンランプ５が配置され、定着ロール表面に設けた温度センサ６の信号により、図示しない温度制御回路においてハロゲンランプ５をオン・オフ制御して、ある一定温度に調整される。また、定着時に記録紙７の上の未定着トナー８の一部が定着ロール１に転移する（以下オフセットと言う）のを防止するために一定量のシリコーンオイルを定着ロール１に供給するオイル供給装置９が設けられている。

【０００３】一方加圧ロール２は、芯金ロール１０にシリコーンゴム等の比較的厚い耐熱弾性体１１が被覆されたものである。この弾性体１１の弾性変形によってロール１、２の圧接部が形成される（以下これをニップと言う）。このニップ領域に未定着トナー像を通過させ、圧力と熱エネルギーの作用により定着するものである。ニップを通過した記録紙７は、トナーの粘着性のため定着ロール１に巻きついてくるので、それを剥がすための剥離爪１２が設けられている。

【０００４】しかし前記定着方式を用いてより高速に定着しようとした場合、トナーと紙に同じだけの熱エネルギーと圧力を与えなければならない。そのためにはニップ幅を定着速度に比例して広くする必要がある。ニップ幅を広くするのに、両ロール間の荷重を大きくする方法、または弾性体の厚さを厚くする方法と、ロール径を大きくする方法がある。

【０００５】荷重を大きくする方法や弾性体の厚さを大きくする方法では、ロールの撓みに起因するニップ幅の形状がロール軸に沿って不均一になったり、定着むらや紙しわが発生するため、荷重と弾性体厚みにはおのずと限界がある。またロール径を大きくする方法は、前記のような品質上の問題点はないが、装置が大型になり、またロールを室温から定着可能温度まで上昇させるまでの時間（以下ウォームアップタイムと言う）が長くなってしまうという問題点を有する。

【０００６】これらの問題点を解決し、より高速化に対応できるようにするため、特開昭６１－１３２９７２号公報に記載されている図２に示すようなベルトを用いた方式が提案されている。（以下この方式をベルトニップ方式と言う）。図２に示すベルトニップ方式は複数の（ここでは２つ）の支持ロール１３、１４に回転可能に張架されたエンドレスベルト１５と、このエンドレスベルト１５に接触してベルトニップを形成する定着ロール１を備えている。定着ロール１とエンドレスベルト１５とのベルトニップ間に、未定着トナー像８が形成された紙７が通過し、この時、ベルトニップ間の圧力と熱エネルギーによって定着を行うものである。ベルトニップ通過後、紙は剥離爪１２によって剥がされ、定着装置の外部に排出される。このような構成にすることにより、エンドレスベルト１５と定着ロール１とのベルトニップの幅が従来のロールニップ方式によるニップ幅よりも容易に大きくとることができるので、高速化対応が可能となる。また同じ定着速度で比較した場合には、ロールニップ方式の定着ロールより小型化が達成される。

【０００７】

【発明が解決しようとする課題】しかし前記のようなベルトニップ方式の定着装置では、ベルトニップの後方に紙を剥離するための剥離爪１２が必要である。トナー画像が載った記録紙はベルトニップ出口以降剥離爪１２の位置まで巻きつき、そこで強制的に剥離されることになる。通常の画像たとえば白黒画像では、記録紙の先端を剥離爪１２で剥離すれば、それより後方の紙は、紙の腰の強さにより自然に剥がれるために、記録紙の剥離はそれ程困難ではない。

【０００８】しかし３色（シアン、マゼンタ、イエロー）のトナーが多量に載った記録紙を目的の色になるように充分に溶融・混色させて発色・定着させるカラー画像を定着する場合には、紙の先端を剥離爪１２で剥離してもその後方の紙は定着ロールから容易に剥がれないため、画像は常に剥離爪１２でこすられることになる。剥離爪１２でこすられる時のトナー像は未だ溶融状態であるため画像は傷ついてしまい、使用に耐えられないものになってしまう。これを防止するためには、紙厚が厚く、つまり紙の腰が強く、定着ロールに巻きつきにくい紙だけに限定すればこの問題は起こらないが、これは根本的解決ではない。

【０００９】また従来のベルトニップ方式では、ベルトの寄りやベルトの波打ち、そして記録紙のしわという現象が起こりやすいものであった。ベルトニップ方式は、ベルトを張架しているロールの円筒度の表面性、またロール間の平行度の不均一、さらにはベルト周長の不均一、定着ロールとの圧接力の左右のアンバランスなどにより、幅方向にずれ動いてしまう。従って、ベルトの幅方向の動きをある程度の範囲内に抑える手段が必要である。

【００１０】従来この問題を解決するために、ベルトの幅方向の動き、すなわちベルトの寄りを光学的、機械的、電気的に検知し、ベルトに張架している複数個のロールのうちいずれか一つのロールを変位ロールとして、他を固定ロールとして、両者のロールの軸を交差させることにより、ベルトの寄りを制御していた。しかし、変位ロールを動かしてその軸を他の固定ロールの軸と交差させるとベルトの張力のバランスがくずれ、ベルトに波打ちが発生する。特に本発明のように、ベルトが高温の定着ロールに接している場合には、熱によるストレスが大きくなり、ベルトのしわ、そして破損という現象が発生するという問題点があった。

【００１１】本発明の第１の目的は、剥離時における画像損傷の問題点を解決する定着装置を提供することである。本発明の第２の目的は、白黒画像に限らず、カラー複写機にも適用可能な新規のベルトニップ方式の定着装置を提供することである。本発明の第３の目的は、多量のトナーが載った紙厚が薄く、紙の腰の弱い記録紙を発色定着させる場合でも、剥離爪を必要とせず、ベルトニップの出口において、何の剥離装置も用いずに剥離できる（以下このことをセルフストリッピングと言う）ベルトニップ方式の定着装置を提供することである。

【００１２】本発明の第４の目的は、ベルトの寄りやベルトの波打ち、記録紙のしわが生じないベルトニップ方式の定着装置を提供するとともに、安定したベルト走行

とベルトの長寿命化を達成することである。さらに本発明の第5の目的は、高速条件に対しても、連続運転条件に対しても、様々な用紙に対しても画像ずれのない安定した画像を保証できるベルトニップ方式の定着装置を提供することである。

【0013】

【課題を解決するための手段】本発明によれば、転写材上の未定着トナー像を定着する熱定着ロール型定着装置において、0.5mm 以上の弾性体が被覆された熱定着ロールと、複数の支持ロールによって張架された耐熱ベルトとを設け、該耐熱ベルトと前記定着ロールとの間にニップを形成するよう耐熱ベルトを定着ロールの廻りに所定角度だけ巻付け、前記ニップの出口において前記耐熱ベルト内側に圧力ロールを配設し、該圧力ロールを請前記耐熱ベルトを介して前記熱定着ロールに圧接することにより、前記熱定着ロールの弾性体に歪みを生じさせることを特徴とする定着装置が提供される。

【0014】前記熱定着ロールの弾性体の円周方向の歪み量εは、ε≧0.5%の関係式を満足するものであってもよい。前記耐熱ベルトは少なくとも3つ以上の支持ロールにより張架され、該支持ロールの一つは変位ロールで他の支持ロールは固定ロールで構成され、該変位ロールはロール軸の位置を他の固定ロールのロール軸と交差するように移動できるよう構成されてもよい。

【0015】前記変位ロールの中心軸は、前記耐熱ベルトの回転方向に対して該変位ロールに最も近い上流側と下流側に位置する2つの前記固定ロールの中心軸を焦点とする楕円軌跡に沿って変位するよう構成されてもよい。前記熱定着ロールは2つの固定ロールの間において張架された耐熱ベルトとニップを形成するよう構成されてもよい。

【0016】前記熱定着ロールと耐熱ベルトとのニップ領域の前記圧力ロールの上流側において、耐熱ベルト内側から該耐熱ベルトを介して熱定着ロールに圧接する弾性体ロールを設けてもよい。さらに本発明によれば、熱定着ロールと、複数の支持ロールによって張架された耐熱ベルトとを圧接させてニップを形成し、該ニップ領域において定着を行う定着装置において、前記ニップ領域の耐熱ベルト内側に熱定着ロールの表面温度を検出する温度センサが配設されていることを特徴とする定着装置が提供される。

【0017】カラー画像の定着は多層の未定着トナー像を目的の色に発色するため、トナーに多量の熱を与えなくてはならないことを考えると、幅広いニップを形成できるベルトニップ方式が適する。発明者は薄紙でもセルフストリッピングできる方法、つまり定着ロールと溶融トナーとの付着力を減少させる方法を研究している中で、次のような現象を発見した。

【0018】それは、溶融トナーと定着ロール表面との界面の付着力は、単に両者の界面化学的な材料物性値だけでは決まらずに、定着ロール表面の歪みの影響を大きく受けるという事実である。つまり、あらかじめ表面歪みを有している定着ロールの表面に溶融トナーが接触している状態から、その表面歪みが瞬間的に解放される状態に移る時に、トナーと定着ロール表面との付着力が減少するという現象である。

【0019】具体的には、定着ロールの表面が外からの荷重によって比較的容易に弾性変形して歪みを生じることができる材料、たとえばシリコーンゴムやフッ素ゴム等の耐熱弾性体が被覆されている場合、ニップ出口近傍において、小径のハードロールが圧接して歪みを受けながら定着され、そしてニップ出口においてその歪みが解放させる瞬間、トナーと定着ロール表面の付着力は急激に低減し、セルフストリッピングされやすいということである。この事実は次のモデル実験によって、さらに明確に証明される。

<モデル実験>ここでは、トナーとロールの付着力が定着ロール表面の歪みの影響を受けるという事実をモデル実験により明らかにする。

【0020】弾性体（Siゴム）が2.0mmの厚さに被覆された定着ロールA（ソフトロール）とテフロンが50μm被覆された定着ロールB（ハードロール）がいずれも130℃の温度に調整されている。3.0mg/cm²の量のカラートナー像が転写された記録紙のトナー面を前記定着ロール表面に圧力X Kg/cm²で10秒間押しつける。その後500mm/secの速度で急激にトナーとロール界面を引き剥がす。この時引き剥がすのに必要な荷重を荷重交換器を介して記録する。図3に付着力検出器とその装置の概略を示す。16は記録紙7の背面を接着する部分、17は荷重伝達棒、18は荷重変換器、19は記録計である。このようなモデル実験で得られた結果を図4に示す。

【0021】これにより弾性体が被覆された定着ロールAの場合、押しつける荷重が大きくなるほど引き離す力が小さくなり、そしてある荷重以上では引き離す力がゼロになることがわかる。しかし、定着ロールB（ハードロール）では、あらかじめ押しつけている荷重の影響は殆どんど受けず、引き離す力は常に一定である。引き離す力はトナーとロールの界面の付着力に相当する。弾性体ロール（定着ロールA）の場合、付着力は単にトナーとロール表面材質だけでは決まらずに、トナーの押しつけ荷重の増大とともに付着力が低減するのである。この押しつけ荷重増大による付着力低減のメカニズムは明確には究明できていないが、発明者らは現在次のように考えている。

【0022】弾性体が被覆されたソフトロールは圧力を加えると表面が変形し、歪みが生じた状態でトナーと接触している。この歪み状態から急に圧力を取り除くと歪みが解放されて元の状態に戻る。この時にトナーとロールの界面にミクロなスリップを生じる。このミクロなスリップの存在が付着力の低減効果であるという仮説であ

る。定着ロールBのように表面が変形しないハードロールでは、歪みが生じないのでミクロなスリップは存在し得ない。このため、付着力低減効果は現れない。本発明はこの考えをベルトニップ方式に適用したものである。

【0023】さらに、上記第5の目的を解決するために、本発明によれば、転写材上の未定着トナー像を定着する熱定着ロール型定着装置において、0.5mm以上の弾性体が被覆された熱定着ロールと、複数の支持ロールによって張架された耐熱エンドレスベルトとを設け、該エンドレスベルトと前記定着ロールとの間にニップを形成するようエンドレスベルトを定着ロールの廻りに所定角度だけ巻付け、前記ニップの出口において前記エンドレスベルト内側に圧力ロールを配設し、該圧力ロールを前記ベルトを介して前記熱定着ロールに圧接することにより、前記熱定着ロールの弾性体に歪みを生じさせるようにし、前記定着ロールを駆動し、エンドレスベルトを従動としたことを特徴とする定着装置が提供される。

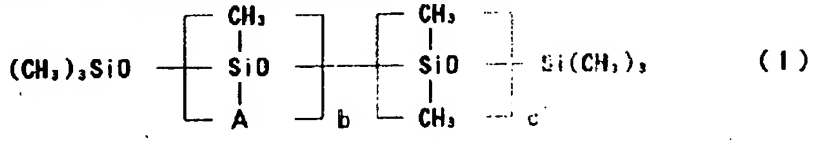
【0024】本発明者らは、画像ずれのない定着装置の実現のため鋭意研究努力した結果次の3点を改善することにより大幅に問題点を改善することを見い出した。その改善点の1つは、従来駆動システムは、ベルトを張架するロール群により駆動されていたが、定着ロールを直接駆動する方式を採用した方が最も安定した画質を得ることができるというものである。

【0025】すなわち、定着装置全体を駆動する方法と＊して、①定着ロールを駆動する方法、②エンドレスを駆動する方法、③両方を駆動する方法の3つが考えられるが、これらの方法のうち、①の定着ロールを駆動する方式が最も安定した画質が得られるというものである。改善点の2つ目は、エンドレスベルトの表面性を規定したことにある。すなわち、従来、エンドレスベルト材料として、75μm厚のポリイミドフィルムや強化学繊維入りのテフロンフィルムを使用していたが、更に表面特性として、用紙との摩擦係数が小さいものが画像ずれが少ないことが判明した。それによれば静摩擦係数μは、0.40以下、より好ましくは0.30以下が画像ずれに対して有効である。これは、用紙裏面とエンドレスベルト面とを故意にすべらせ、定着ロールとトナー粉体のある用紙表面側には　すべりを生じないようにしているものである。（定着ロールと紙との静摩擦係数は0.8以上が好ましい。）

改善点の3つ目は、定着ロールに供給する離型剤として、従来、ジメチルポリシロキサンから成るシリコンオイルを使用していたが、ポリイミド製エンドレスベルトに対して、特に濡れ性の優れた下記一般式（1）で表され且つその25℃における粘度が10～100,000cs の、アミノ基を有するアミノ変性シリコンオイルを使用することが有効である。

【0026】

【数2】



（1）

【0027】〔但し、式中、Aは－R′－X（ここで、R′は炭素数1～8のアルキレン基を示し、Xは－NH_2 または－$NH(CH_2)_2NH_2$ を示す）で表され、b およびc はそれぞれ0＜b ≦10、及び10≦ c ≦1000である〕

この理由は、明確には判っていないがベースフィルムであるポリイミドフィルムのイミド結合に対して、アミノ変成シリコンオイル中のアミノ基が有効に働き、ポリイミドフィルム面のオイルの濡れ性を改善しているためと思われる。すなわちポリイミドフィルム表面に定着ロール表面を伝わって供給されるアミノ変性シリコンオイルを塗布することにより、用紙裏面とエンドレスベルトとのすべりを大きくさせ、画像ずれを防止するものである。

【0028】使用するアミノ変性シリコンオイルのうち、好ましくはAとして－$(CH_2)_3NH_2$ 又は－$(CH_2)_3NH(CH_2)_2NH_2$ が好適であり、その濃度としてのb、cはそれぞれ好ましくは、0.01＜b＜1及び50≦ c ≦300 、より好ましくは0.02≦ b ≦0.5 及び100 ≦ c ≦200 でオイルの粘度として好ましくは50～1000cs、より好ましくは、100 ～400 csのオイルが好適である。

【0029】また特にこのアミノ変性シリコンオイルを使用した場合には、コピーモードとして両面コピーをとるという場合においても、一度定着したトナー像を劣化させることがないことが判明した。これに対し、ジメチルオイルを使用した場合には、両面コピーをとった場合に一度定着したトナー画像が粗くなってしまうことがあった。これらの違いは、官能基がもたらす親和性の違いにより、表面の離型性まで影響を受けているようである。

【0030】これらの3つの改善点は、それぞれ独自に効果のある事柄であり、併用することにより画像ずれの問題点は極小化される。またこれら3つの改善点に共通する思想は、画像ずれを防止するために用紙の裏面とエンドレスベルトの上面との間でむしろ故意にすべりを生じさせて、歪みを生じた定着ロール表面スピードとエンドレスベルトの表面スピードの不適合の解消を狙ったものである。

【0031】

【実施例】図2は本発明を達成するためのベルトニップ方式の1実施例を示す。

＜実施例1＞定着ロールとしては、金属コアの表面に弾

性体が被覆されたいわゆるソフトロールを用いることが前提条件となる。定着ロール（ソフトロール）に複数個のロールで張架されたエンドレスベルトを接触させてベルトニップを形成し、そのニップ出口に圧力ロールをベルトを介して定着ロールに圧接する。この時定着ロールの表面は弾性変形し、その表面に歪みが与えられる。この圧力ロールは定着ロール表面に歪みを生じさせる機能を有している。定着ロールの歪みを低荷重で効率良く与えるために、圧力ロールは定着ロールより小径で、その表面は硬質である方が望ましい。

【００３２】本発明を実施例１を用いてさらに詳しく説明する。実施例１で用いた定着装置を図５に示す。定着ロール１は、外径46mm、内径40mmのアルミニウム円筒で成る中空ロール３に下地層２０としてＨＴＶシリコンゴム（ゴム硬度45度）が２mmの厚さで被覆されたもので、さらにその表面にトップコート層２１としてシリコンＲＴＶゴムを50μｍの厚さにディップコートし、鏡面状態に近い表面に仕上げられている。加熱源として400Wのハロゲンランプ５が内部に設けられ、定着ロール１の表面は、温度センサ６を介して温度コントローラ（図示せず）により150 ℃に調節される。また離型剤としてジメチルシリコンオイル粘度300cs(KS-96:信越化学製）がオイル供給システム９により均一に供給されている。一方エンドレスベルト１５は厚み75μｍ、300mm、周長288mmのポイリミドフィルムであり、４個のステンレス製ロール２２、２３、２４、２５により、10Kgの張力で張架されている。それぞれの直径は22、20、20、18mmである。直径18mmのロール２５（圧力ロール）は加圧手段としての圧縮コイルスプリング２６によって定着ロール１の中心に向かって付勢されており、ベルト１５を定着ロール１に圧着している。定着ロール１へのベルト巻付け角度は45°でありこの時ベルトニップの幅は19.6mmとなる。ベルトニップの出口は圧力ロール２５がベルトを介して圧着されているため、定着ロールの弾性体は変形し、その表面には歪みが発生する。モータ２７からの駆動力は直径22mmの駆動ロール22に伝達され、ベルト及び定着ロールは矢印２８の方向に250mm/sec の速度で従動回転する。

【００３３】この定着装置に各種重量（厚さ）の紙の上にカラートナーが3.0mg/cm² の密度で転写された未定着トナー像を通し、ニップ出口におけるセルフストリッピング性を調べた結果を図６に示す。この図の中で紙の送り方向Ａとは紙の繊維が定着ロールと平行になるように送った場合であり、送り方向Ｂとは垂直の場合である。送り方向Ａの場合は紙の構造上、紙の腰が弱く同じ紙厚でもセルフストリッピングがしにくい傾向にある。以上のデータより、圧力ロール荷重を増加していくに従い坪量の小さい（紙厚の薄い）紙でもセルフストリッピングが可能となることが判る。

＜比較例１＞ここでは定着ロールがハードロールの場合について述べる。実施例１と同じ条件で、定着ロールだけをシリコンの定着ロールＡ（ソフトロール）からテフロンが50μmコーティングされた定着ロールＢ（ハードロール）に変えた場合のセルフストリッピング性について調べた。その結果、図７に示すようにすべての圧力ロール荷重においてセルフストリッピングが不可能であった。

＜歪みの測定＞ある荷重における弾性体ロールの表面歪みは、次のようにして実測が可能である。一般にハードロールとソフトロールがある荷重のもとで圧接した場合、ニップ領域でソフトロール表面は弾性変形し、その表面の円周方向はある歪みεを生じる。この状態でロールを回転させニップ領域を記録紙が通過すると、記録紙は歪みを生じたニップ領域で搬送される。このため歪みを生じた弾性体ロール１回転で送りだされる記録紙の長さは、実際にロール周長の長さより円周方向歪みε分だけ短い長さが大きくなる。

【００３４】つまり、

ε＝｛（弾性体ロール１回転で送りだされる記録紙の長さ）－（ε＝０の時における弾性体ロールの周長）｝－｝

という式になる。この方式から実際の歪みεが実測可能となる。本発明での歪みはこの測定法の値である。図８に実施例１での荷重と歪みの関係を示す。これにより歪み0.5%から90g/m² の重量のＢ方向送りの紙のセルフストリッピングが可能となり、歪み2.5％からは一番剥離しずらい薄紙（55g/m² ）のＡ方向のセルフストリッピングが可能となる。

【００３５】ニップ出口における歪みの解放によるトナーと定着ロール界面の付着力の低減効果はベルトニップ方式だけでなく、ロールニップ方式にも適用が可能である。この場合、定着ロールの表面硬度は加圧ロールと同等またはそれより軟らかい方が定着ロールの歪みを生じやすい、その分セルフストリッピングしやすい。

＜比較例２＞実施例１と同等の定着装置において、ベルト装置を取り除き、その代わりに加圧ロールを設けて定着ロールとのニップの形成を行う方式（つまりロールニップ方式）のセルフストリッピング性について、荷重との関係を調べる。

【００３６】ここで用いた加圧ロールは直径が定着ロールと同じ40mmであり、その表面は50μｍテフロンコーティングがされている。両ロールの表面温度は160 ℃に調節され、ロールニップ間に実施例と同じ未定着トナー像を250mm/sec の定着速度で通し、その時のセルフストリッピング性を調べた。図９にその結果を示す。またこの定着荷重の荷重と表面歪みの関係を図１０に示す。ロールニップ方式の場合、歪み1.0％から90g/m² 以上の重量の紙のセルフストリッピングが可能となり、歪み2.5％から一番剥離しずらい薄紙(55g/m²)のＡ方向のセルフストリッピングが可能となる。これ

らの値を本発明でのベルトニップ方式と比較したものを図１１に示す。

【００３７】これからわかるように、ベルトニップ方式はロールニップ方式よりも小さな歪みでセルフストリッピングができる。この理由としてベルトニップ方式では、ベルトニップの出口近傍で瞬間的に歪みを与えているために、小さな歪みでも歪みの変化率が大きく、その分、トナーと定着ロール界面でミクロなスリップが発生しやすいためと考えられる。

【００３８】またベルトニップ方式の総荷重は10～20Kgであるのに対し、ロールニップ方式で80kg以上が必要である。ベルトニップ方式では大幅な荷重低下が実現可能であり、このため定着ロールの表面磨耗装置の駆動トルクの低減が可能となる。また荷重が少ない分ロール剛性は小さくてすみ、ロール径やロールコアの肉厚の薄肉化が達成できる。

【００３９】さらにまた、従来のロールニップ方式では非定着時に両ロールを離間させて定着ロールの変形を防止する必要があったが、本装置でその必要はなく装置の簡略化が可能となる。さらにまた長尺ロール、たとえば大図面用の定着装置への適用も可能となる。一般に、ゴムは熱伝導率が小さく熱的には断熱材として作用する。定着ロールの温度の安定化には、なるべくゴムの肉厚は薄い方が良い。従来のロールニップ方式では、広いニップ幅を得るには定着ロールのゴムの肉厚を厚くしなければならず、ゴムの薄肉化には限界があった。しかし本発明のベルトニップ方式では、ベルトによってニップが形成されるためゴム厚を厚くする必要はなく、ゴムはセルフストリッピングできる歪みが均一に形成できる厚みさえあれば良い。このようにベルトニップ方式はニップ幅と歪みをそれぞれ独立して変化できるという特徴を有する。

【００４０】具体的には、従来のロールニップ方式では少なくとも２㎜以上、望ましくは3.０㎜以上の弾性体が必要であったが、本発明では0.５㎜以上、望ましくは1.０㎜以上あれば良く、温度の安定化とウォームアップタイムの短縮に長所を有する。従来のロールニップ方式では加圧ロールに剥離爪を用い、加圧ロールへの紙の巻き付きを防止していたが、本ベルトニップ方式ではベルトからの紙の剥離位置におけるベルトの曲率を紙が巻き付かない大きさにすることが可能である。定着ロール、ベルトとも剥離爪を必要としないという長所を有する。これにより、剥離爪によるロール、ベルトの損傷や、剥離爪によって掻き取られた離型剤が爪の先端にたまり、それが紙の先端に転移し、離型剤のしみが発生するといった従来のロールニップ方式の問題点も解決できる。

<実施例２>従来、温度センサによるロール傷という問題があり、これがロールの短命性や画質劣化を引き起こしていた。特に表面に弾性体が被覆された弾性体ロールではこの影響が大きかった。本発明では図１２に示すように温度センサ６をベルト内面に配し、ベルトを介してベルトニップ内の定着ロールの温度を検出することによって温度制御することが可能となる。このためセンサによる損傷の問題は完全に解決される。

<実施例３>実施例１のベルトニップ方式定着装置を用いて圧力ロールの荷重を変えて定着実験を行ったところ、本発明のベルトニップ方式では新たな画質欠陥の問題があることを見いだした。それは圧力ロールの荷重を増大していくと、ある荷重以上から画像がずれてしまうという現象である（この現象は比較例１でのハードロールを用いたベルトニップ方式では起こらない。）。画像ずれと荷重の関係を調べた結果を図１３に示す。このメカニズムに関して発明者らは次のように考えた。

【００４１】一般に弾性体ロールの表面速度はその歪みεの影響を受け、弾性体円周方向歪みεが存在する場合、そこでの表面速度Ｖ，はＶ，＝（１＋ε）Ｖになる。Ｖはε＝０における表面速度を示す。本発明のベルトニップ方式では、ニップ出口において圧力ロールからの荷重を受け、円周方向歪みεが存在する。そして、その場所の速度Ｖ，はベルトだけのニップ領域との速度Ｖ（ここではε＝０である）とは、わずかながら速度差が存在する。このようにベルトニップ内でロール表面速度に差が存在する場合、速度差がある値より大きくなると、ロール表面に密着している紙は、ついにはその速度差を吸収できなくなり、画像ずれが生じるという仮説である。セルフストリッピングが可能で画像ずれが生じない歪みの範囲は0～3.75%である。この画像ずれの問題を解決するために発明者らは前記の仮説に従い、次の解決策を思い出した。

【００４２】それは速度差に起因するずれを極力押さえ込むために、圧力ロールの上流側に柔らかい弾性体で被覆された圧力補助ロール２９を用いる方法である。（図１２参照）この圧力補助ロールは、ベルト内面からベルトを定着ロールに密着させ、ベルトと定着ロールの表面がずれるのを防止するためのロールである。実施例２では実施例１の定着装置の圧力ロールの上流側11mmのところに直径8mmのステンレスコアに、厚み６㎜のSiゴム発砲体（ゴム硬度27°／アスカーＣ型硬度計）を被覆した弾性補助ロールを荷重４Kgで圧接した。このとき、画像ずれは図１３に示すように圧力補助ロール２９がない場合に比べて約10Kgの荷重増加が可能となりその分セルフストリッピング性が向上するとともに、定着性の向上も得られた。また、この圧力補助ロールの採用により、ベルト張架ロールを小径化しても、ベルトとロールの定着力は低下しないのでベルトの寿命を増大できるという長所もある。

【００４３】さらに、ベルトの寄りの問題を解決するために発明者らはベルトの張架方式及び変位ロールの変位方向の検討を行った結果、次の事実を知るに至った。図１６～１８にこの事実の説明を行う。図１６では、ベルトが３本のロールで張架されている場合を示している。まず

第１の事実は、ベルトは少なくとも３つ以上のロールによって張架され、そのうちの何れか１つを変位ロール２３とし、他の２つ又はそれ以上を固定ロール２４、２５とし、ベルトニップは固定ロール間で行うことが非常に効果的である。変位ロール２３の軸を固定ロール２４、２５の軸と交差させた場合、ベルトは強制的に捩じられるため、変位ロールの上流側と下流側で波打ちが発生する。しかしこの波打ちは、両隣の固定ロール２４、２５によって規制され、固定ロール間に張架されたベルト面はほとんど波打ちがなくなり、ベルトは平面を保つことになる。これは固定ロールは互いに平行関係であるためである。ベルトニップをこの平面で形成することにより、定着ロールによるベルトの波打ち、しわ、破損を最小限に抑えることが可能となるものである。またこのベルトニップに記録紙を搬送した場合に、記録紙のしわもなく画像の乱れもないことが判明した。

【００４４】さらに変位ロールの軸の変位方式について研究を行った結果、第２の事実を得るに至った。それは変位ロールの軸の一端をベルトの回転方向に対して、変位ロールに最も近い上流側と下流側の２つの固定ロール２４、２５の中心軸Ａ、Ｂを焦点とする楕円軌道３０に沿って変位させた場合に、ベルトのストレスが最も少なく、このため波打ち、しわ、破損も最小限に抑えることが判明した。そしてこの場合、変位ロールを変位させるのに必要な力は小さくて済み、変位装置の小型化が達成される。これは変位ロール軸を楕円軌道３０に沿って変化させた場合、変位後のベルトの周長は変位前とは変わらないためで変位前後でベルトの張力が変わらないことによる。

【００４５】本方式によるベルトの寄り補正機構を図１７を用いて説明する。ベルトの左右いずれかに寄りが発生した場合、ベルトが左右のベルト端部に設けられたフォトセンサ３１の光を遮り、その寄りがどちらに発生したかが検知される。ベルトが例えば図１７において手前側に寄り、フォトセンサがそのベルトの寄りを検知すると、パルスモータ３２に信号を送ってパルスモータを規定量回転させ、変位ロールの手前側の軸の位置をＤ方向に変位させる。この時変位ロール２３の軸受がＡ、Ｂを焦点とする楕円軌道３０に沿って変位できるようにガイド３３が設けられている。これにより、ベルト１５は手前側とは反対側に寄りはじめ、ベルトの位置が補正される。

<実施例４>定着ロール１は金属コアの表面に弾性体が被覆されたいわゆるソフトロールで外径４６mm内径４０mmのアルミニウム円筒３に下地層としてＨＴＶシリコンゴム（アスカーＣ硬度４５°）が２mmの厚さに被覆されたもので、さらにその表面にトップコート層として、シリコンゴム２１を５０μmの厚さにコートし、鏡面状態に近い表面に仕上げられている。加熱源として、400Wのハロゲンランプ５が内部に設けられ、温度センサ６にて表面温度が検出され、図示しない温度コントローラにより150℃の一定温度に制御される。

【００４６】また離型剤として、官能基として－(CH_3)，NH₂ を有するアミノ変性シリコンオイル（オイル粘度300cs、信越化学製、ｂ＝0.1、ｃ＝130（X-21-7763G）がオイル供給システム９により均一に供給されている。一方、エンドレスベルト１５は、厚み７５μm、静摩擦係数0.2、幅300mm、同長さ288mmのポリイミドフィルムであり、４本のステンレス製ロール２２、２０、２０mmである。直径１８mmのロール２５（圧力ロール）は、加圧手段としての圧縮コイルスプリング２６によって定着ロール１の中心に向かって総荷重として２５Kgで付勢されており、ベルト１５を定着ローラに圧着している。定着ロールへのベルトの接触は巻付け角度としてθ＝42°であり、このときのベルトニップの幅19.6mmとなっている。ベルトニップの出口は圧力ロール２５がベルトを介して圧接されているため、定着ロールの弾性体は変形し、その表面には歪みが発生する。モータ２７からの駆動力は、定着ロール１に伝達され、ベルトは定着ロールによって矢印２８の方向に200～350mm /secの速度で駆動回転することができる。

【００４７】この定着装置を使用して、各種Ａ４サイズの紙上にカラートナーが2.5mg/cm² の密度で転写されたカラー画像を、定着スピード250mm/sec から350mm/secで処理した。このとき定着ロールの設定温度は、150℃、155℃、160℃、180℃とそれぞれ変えて、２０枚連続で通紙を行い、それらの画像ずれの評価を行った。その結果、表１に示すように、350mm/secのような高速においても、両面コート紙のような平滑な用紙であっても、特に、２０枚連続通紙というオイルの供給が追いつかない厳しい条件下においても、すべての条件下で画像ずれのない定着が得られることが分かる。

【表１】

15　　16

定着スピード	用紙の種類		
	55g/m²	64g/m²	両面コート 100g/m²
250mm/sec	○	○	○
300mm/sec	○	○	○
350mm/sec	○	○	○

○……問題なし
△……軽いずれ（許容限度）
×……明らかなずれ（許容限度を超える）

【0049】<実施例5>離型剤として、使用するアミノ基の種類を－$(CH_2)_3NH(CH_2)_2NH_2$ とし、他の条件を同じにしたアミノ変性シリコンオイル（信越化学製X-21-7720）で実施例4と全く同じテストをしたが全く同様のテスト結果が得られた。

<実施例6>離型剤として使用するオイルを従来のアミノ基のないジメチルポリシロキサンオイル（信越化学製＊20

定着スピード	用紙の種類		
	55g/m²	64g/m²	両面コート 100g/m²
250mm/sec	○	○	○
300mm/sec	○	○	○
350mm/sec	△	△	△

○……問題なし
△……軽いずれ（許容限度）
×……明らかなずれ（許容限度を超える）

【0051】<実施例7>離型剤として使用するオイルを実施例1と同じ官能基－$(CH_2)_3NH_2$ を有するアミノ変性シリコンオイル（信越化学製、b＝0.1、c＝1.0、X-21-7763G）とし、ポリイミドのエンドレスフィルムの摩擦係数を0.5に調整したものにした他は実施例4と同じ条件とした。この結果は実施例4と全く同様であった。

<実施例8>離型剤を実施例5と同じ、アミノ基として－$(CH_2)_3NH(CH_2)_2NH_2$ であるアミノ変性シリコンオイル（信越化学製 X-21-7720）に変える他は、実施例7と同じようにエンドレスベルトの摩擦係数を0.5でテストしても、結果は、実施例7と全く同じであった。

<比較例3>離型剤として、従来使用していたアミノ基

＊ KF-393(OS)を使用し他の条件を実施例4、5と同じにしてテストしたところ、画像ずれの結果は表2に示すように高速時の、連続運転の後半に幾分画像ずれを見せた許容レベルであった。

【0050】

【表2】

の、ジメチルポリシロキサンオイル（信越化学製 KF-96 [illegible]）を使用し、実施例7、8と全く同様なテストをしたところ、表3に示すように連続運転の後半1万枚ぐらいから枚になると、より高速時に画像ずれが発生しやすいことが分かった。この結果を本発明者らは、ポリイミドフィルムに対するオイルの濡れ性あるいは親和性にあるのではないかと推論した。すなわち、ポリイミドフィルムのイミド基に対しアミノ基の方がメチル基より親和性があり、連続運転のようなオイル供給が少なくなる条件下においても、有効に付着しているのであろうと推論した。

【0051】

【表3】

定着スピード	用紙の坪量		
	55g/m²	64g/m²	両面コート 100g/m²
250mm/sec	○	○	△
300mm/sec	△	△	×
350mm/sec	×	×	×

○……問題なし
△……軽いずれ（許容限度）
×……明らかなずれ（許容限度を超える）

【００５３】＜実施例９＞エンドレスベルトの表面性のうち静摩擦係数0.30としたものを使用した他は、実施例４と同条件でテストした。尚、静摩擦係数の測定は、新東化学（株）製表面測定機HEIDON-14 型を使用し、上紙（６４g/m²、富士ゼロックス製）に対する静摩擦係数＊（荷重200g）を測定したものである。この結果は全く文字ボケもなく、画像ずれはなく実施例４と同等以上であった。この結果を表４に示す。

【００５４】

＊（荷重200g）

定着スピード	用紙の坪量		
	55g/m²	64g/m²	両面コート 100g/m²
250mm/sec	○	○	○
300mm/sec	○	○	○
350mm/sec	○	○	○

○……問題なし
△……軽いずれ（許容限度）
×……明らかなずれ（許容限度を超える）

【００５５】＜比較例４＞実施例９と同様に、エンドレスベルトの表面性として摩擦係数0.3 のものを使用し、また離型剤として官能基のないジメチルポリシロキサンを使用してテストしたところ、表５のような結果となった。※また、高速時の連続運転時に劣化する傾向はすこし見られたが実用レベルであった。

【００５６】

※

定着スピード	用紙の坪量		
	55g/m²	64g/m²	両面コート 100g/m²
250mm/sec	○	○	○
300mm/sec	○	○	○
350mm/sec	○	○	△

○……問題なし
△……軽いずれ（許容限度）
×……明らかなずれ（許容限度を超える）

【００５７】＜比較例５＞実施例６と同様に、エンドレスベルトの摩擦係数0.40としたものを使用し、今度は定着装置全体の駆動方法として、

① モータ２７により定着ロール１だけを駆動し、他は従動させる方法。

② 上記モータ２８によりエンドレスベルトを張架するロール２を駆動しエンドレスベルトを駆動させ定着ロール１は従動させる方法。

③ 上記両方を駆動源とする方法。

の３種の駆動方法による比較テストを行った。その結果

を表6に示す。

【0058】

【表6】

駆動方法 ＼ 用紙の重量 ＼ 定着スピード	①定着ロール駆動			②エンドレスベルト駆動			③両ロール駆動		
	55g/m²	64g/m²	両面コート 100g/m²	55g/m²	64g/m²	両面コート 100g/m²	55g/m²	64g/m²	両面コート 100g/m²
250mm/sec	○	○	○	△	△	△	○	○	○
300mm/sec	○	○	○	×	×	×	△	△	△
350mm/sec	△	△	△	×	×	×	×	×	×

○……問題なし
△……僅いずれ（許容限度）
×……明らかなずれ（許容限度を超える）

【0059】この結果から定着装置の駆動方法として、①の定着ロールを駆動する方法が画像ずれに対し最も良い駆動方法であることが分かった。

【0060】

【発明の効果】以上の説明から明らかなように、本発明

は従来のベルトニップ方式の定着装置において、ベルトニップ部において定着ロールにベルトを介して圧力ロールを圧接することによって定着ロール表面に歪みを発生することによりセルフストリッピングを可能としたものである。このため白黒の定着装置以外のカラーの定着装置への適用が可能となるものである。また従来のベルトニップ方式の欠点であったベルトの波打ち、しわ、破損等を小型に抑えるベルトの張架方法とベルトの寄り補正機構を導入することによりベルトの寿命を大幅に延ばすことが可能になり、記録紙のしわや、画像の乱れを防止することが可能になった。また本発明のベルトニップ方式はロールニップ方式に比べても高速、高信頼、高画質等多くの長所を有するのであり、産業上その利用価値は非常に大きいものである。

【0061】さらに、本発明は従来のベルトニップ式の欠点である剥離爪による画像こすれの問題はなく、また高速モードにおいても、各種用紙条件下においても、また更に過酷な連続運転条件下においても、画像ずれのない画質を実現することが可能となった。また本ベルトニップ方式は、1対のロール対より構成されるロールニップ方式に比べても高速、高信頼、高画質等多くの長所を有するものであり、産業上のその利用価値は非常に大きいものである。

【図面の簡単な説明】

【図1】従来のロールニップ式定着装置の概略図である。

【図2】従来のベルトニップ式定着装置の概略図である。

【図3】トナーの定着ロールへの付着力を検出する付着力測定器の概略図である。

【図4】定着ロールとしてソフトロール及びハードロールを使用した場合のモデル実験の結果を示すグラフである。

【図5】本発明の第1実施例によるベルトニップ式定着装置の概略図である。

【図6】本発明に使用するソフトロールのセルフストリッピング性を表を用いて示す図である。

【図7】比較例として従来のハードロールのセルフストリッピング性を表を用いて示す図である。

【図8】本発明の実施例によるベルトニップ式定着装置における定着ロールの表面歪みを示すグラフである。

【図9】比較例として従来のロールニップ式定着装置のセルフストリッピング性を表を用いて示すグラフである。

【図10】比較例として従来のロールニップ式定着装置における定着ロールの表面歪みを示すグラフである。

【図11】本発明のベルトニップ式定着装置と従来のロールニップ式定着装置による剥離可能な歪みの差を示すグラフである。

【図12】本発明のベルトニップ式定着装置においてベル

トの内側に温度センサを配置した本発明の第２実施例を示す概略図である。

【図１３】図５のベルトニップ式定着装置における圧力ロールの荷重と画像ずれとの関係を表を用いて示す図である。

【図１４】本発明の第３実施例によるベルトニップ式定着装置を示す概略図である。

【図１５】図１４のベルトニップ式定着装置における圧力ロールの荷重と画像ずれとの関係を表を用いて示す図である。

【図１６】ベルト補正機構を組み込んだ本発明のベルトニップ式定着装置を示す概略図である。

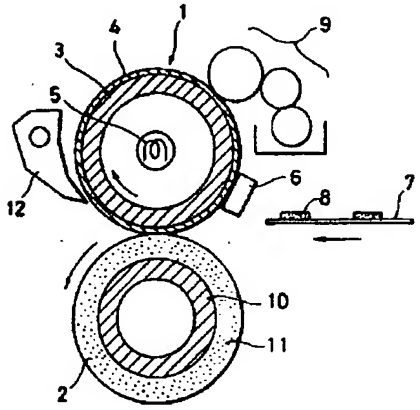
【図１７】本発明のベルトニップ式定着装置に組み込まれたベルト補正機構を示す拡大図である。

【図１８】定着ロールを駆動としエンドレスベルトを従動とした本発明のベルトニップ式定着装置を示す概略図である。

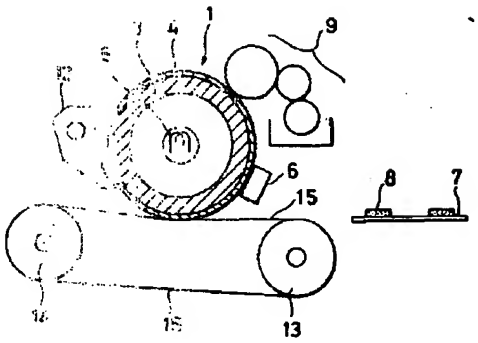
【符号の説明】

1　定着ロール
2　加圧ロール
3　中空ロール
4　テフロン被覆層
5　ハロゲンランプ
6　温度センサ
＊
8　
9　
10　
11　
12　
13　
15　支持ロール
24　
25　
30　
31　
32　
33　

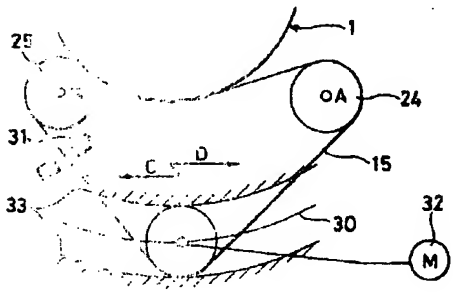
【図１】



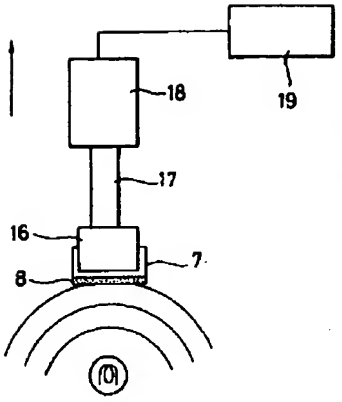
【図２】



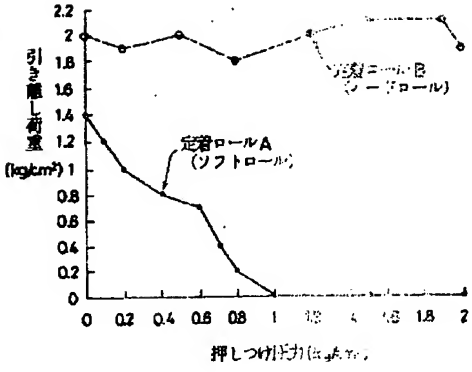
【図１７】



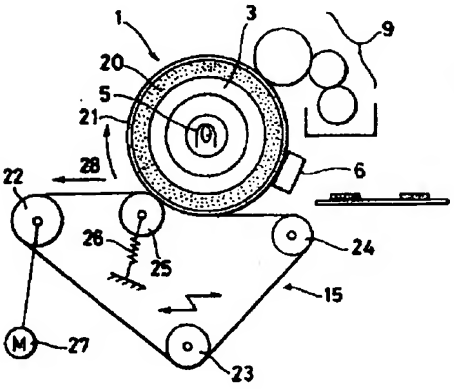
【図3】



【図4】



【図5】



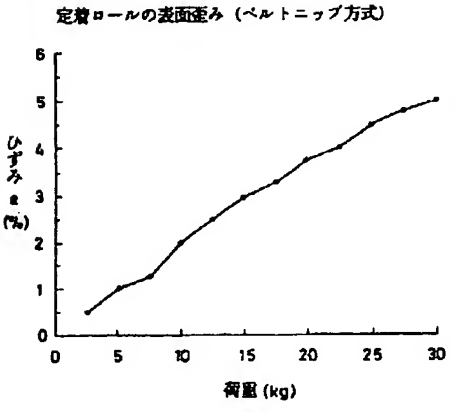
【図6】

ソフトコーンのセルフストリッピング性

紙の坪量 / 送り方向 / 圧力ロール荷重(kg)	55g/m²		65g/m²		90g/m²	
	A	B	A	B	A	B
0	×	×	×	×	×	×
2.5	×	×	×	○	×	○
5.0	×	×	×	○	×	○
7.5	×	○	×	○	×	○
10.0	×	○	×	○	○	○
12.5	×	○	○	○	○	○
15.0	○	○	○	○	○	○
17.5	○	○	○	○	○	○
20.0	○	○	○	○	○	○

○：セルフストリッピング可能
×：セルフストリッピング不可

【図8】



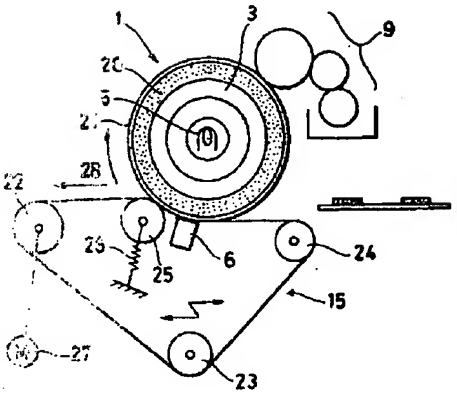
【図7】

ハードロールのセルフストリッピング性

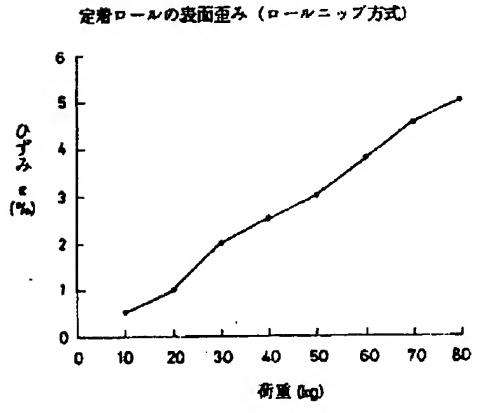
圧力 ロール荷重(kg) ＼ 紙の重量 55g/m² 65g/m² 90g/m² ＼ 送り方向	55g/m² A	55g/m² B	65g/m² A	65g/m² B	90g/m² A	90g/m² B
0	×	×	×	×	×	×
2.5	×	×	×	×	×	×
5.0	×	×	×	×	×	×
7.5	×	×	×	×	×	×
10.0	×	×	×	×	×	×
12.5	×	×	×	×	×	×
15.0	×	×	×	×	×	×
17.5	×	×	×	×	×	×
20.0	×	×	×	×	×	×

○: セルフストリッピング可能
×: セルフストリッピング不可

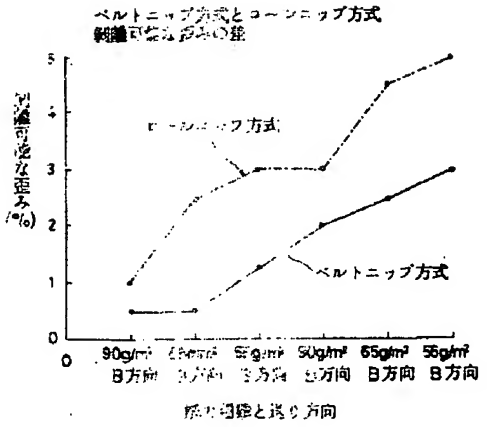
【図12】



【図10】



【図11】



【図9】

ロールニップ方式のセルフストリッピング性

紙の重量 / 送り方向 / 圧力ロール荷重(kg)	55g/m²		65g/m²		90g/m²	
	A	B	A	B	A	B
0	定着せず					
10	定着せず					
20	×	×	×	×	×	×
30	×	×	×	×	×	○
40	×	×	×	○	○	○
50	×	○	×	○	○	○
60	×	○	×	○	○	○
70	×	○	○	○	○	○
80	○	○	○	○	○	○

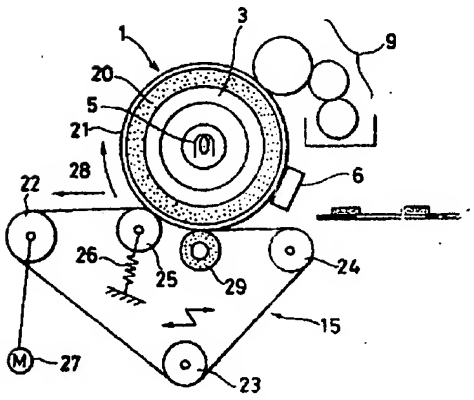
○：セルフストリッピング可能
×：セルフストリッピング不可

【図13】

圧力ロールの荷重(kg)	画像ずれの有無
0	○
5	○
10	○
15	○
20	○
25	×
30	×

○：画像ずれ無
×：画像ずれ有

【図14】



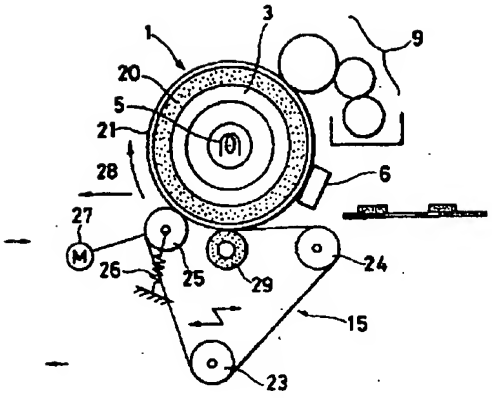
【図15】

画像ずれと荷重の関係

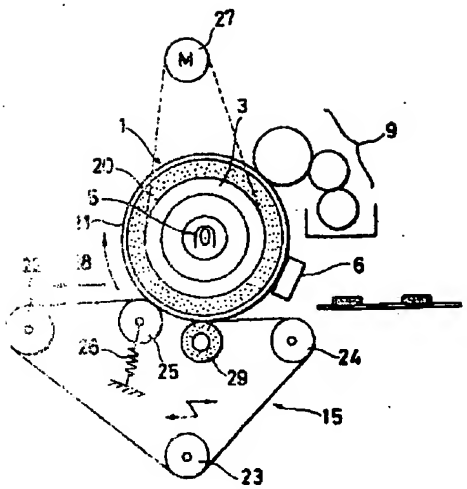
圧力ロールの荷重(kg)	画像ずれの有無	
	圧力補助ロール無	圧力補助ロール有
0	○	○
5	○	○
10	○	○
15	○	○
20	○	○
25	×	○
30	×	○

○：画像ずれ無
×：画像ずれ有

【図16】


1
3
9
20
5
21
10
28
6
27
M
26
25
29
24
15
23

【図18】


27
M
3
1
9
20
5
10
6
25
29
24
15
23

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] in image information recording devices, such as a copying machine, a printer, and facsimile, this invention looks like [the so-called heating roller type fixing equipment which carries out contact heating fixing and the belt nip method fixing equipment which especially consists of a heating roller and belt pressure-welding equipment] the non-established toner image in the record paper, and is related
[0002]
[Description of the Prior Art] As conventional fixing equipment, as shown in drawing 1 , the so-called heating pressure-roll type fixing equipment established by making the pressure-welding field during the roll with which the couple was heated pass a non-established toner image is used abundantly (this is called roll nip method below). In drawing 1 , 1 is a fixing roll and 2 is a pressure roll. The enveloping layer 4 of the Teflon (trademark of Du Pont) which has thermal resistance and a mold-release characteristic is formed in the front face of the hollow roll 3 of a metal with high thermal conductivity, such as aluminum, the halogen lamp 5 is arranged as a source of heating inside the hollow roll 3, and the fixing roll 1 carries out on-off control of the halogen lamp 5 in the temperature-control circuit which is not illustrated with the signal of a temperature sensor 6 formed in the fixing roll front face, and is adjusted to a certain constant temperature. moreover, the time of fixing -- a part of non-established toner 8 on the recording paper 7 -- the fixing roll 1 -- transferring (henceforth offset) -- in order to prevent, it is prepared in the oil feeder 9 which supplies the silicone oil of a constant rate to the fixing roll 1
[0003] On the other hand, as for a pressure roll 2, the comparatively thick heat-resistant elastic bodies 11, such as silicone rubber, are covered by the rodding roll 10. The pressure-welding section of rolls 1 and 2 is formed of the elastic deformation of this elastic body 11 (this is called nip below). This nip field is made to pass a non-established toner image, and it is established by operation of a pressure and heat energy. Since the recording paper 7 which passed the nip coils around the fixing roll 1 for the adhesiveness of a toner, the ablation presser foot stitch tongue 12 for removing it is formed.
[0004] however, when it is going to fix to high speed more using the aforementioned fixing method, it is the same as a toner and paper -- you have to give the heat energy and the pressure of ** For that purpose, it is necessary to make nip width of face large in proportion to fixing speed. The method of enlarging the load during both rolls or the method of thickening thickness of an elastic body, and the method of enlarging the diameter of a roll are to make nip width of face large.
[0005] By the method of enlarging a load, or the method of enlarging thickness of an elastic body, since it becomes uneven or the fixing mark and a paper wrinkling occur [the configuration of the nip width of face resulting from bending of a roll] along with roll axis, there is a limitation in a load and elastic body thickness naturally. Moreover, the method of enlarging the diameter of a roll has the trouble that time (henceforth a worm uptime) until equipment becomes large-sized and it raises a roll from a room temperature to the temperature which can be established will become long, although there is no trouble on the above quality.
[0006] Since these troubles are solved and it enables it to correspond to improvement in the speed more, the method using the belt as shown in drawing 2 indicated by JP,61-132972,A is proposed. (This method is called belt nip method

below) . The belt nip method shown in drawing 2 is equipped with the fixing roll 1 which contacts the endless belt 15 laid possible [rotation] by the support rolls 13 and 14 which are plurality (here two), and this endless belt 15, and forms a belt nip. The paper 7 in which the non-established toner image 8 was formed between the belt nips of the fixing roll 1 and an endless belt 15 passes, and it is established with the pressure and heat energy between belt nips at this time. After belt nip passage, paper is removed by the ablation presser foot stitch tongue 12, and is discharged by the exterior of fixing equipment. Since the width of face of the belt nip of an endless belt 15 and the fixing roll 1 can take greatly easily by making it such composition rather than the nip width of face by the conventional roll nip method, high speed correspondence is attained. Moreover, when it compares at the same fixing speed, a miniaturization is attained from the fixing roll of a roll nip method.

[0007]

[Problem(s) to be Solved by the Invention] However, the ablation presser foot stitch tongue 12 for exfoliating paper is required of the above fixing equipments of a belt nip method behind a belt nip. The recording paper in which the toner picture appeared will coil after a belt nip outlet to the position of the ablation presser foot stitch tongue 12, and will exfoliate compulsorily there. If the nose of cam of the recording paper is exfoliated by the ablation presser foot stitch tongue 12, since back paper will separate automatically with the nerve of paper from it, usual picture, for example, monochrome picture, ablation of the recording paper is not so difficult.

[0008] However, since the paper of the back does not separate easily from a fixing roll even if it exfoliates the nose of cam of paper by the ablation presser foot stitch tongue 12, when melting and the color picture fixed [which is fixed and colors by carrying out color mixture] are fully established so that it may become the target color about the recording paper in which the toner of three colors (cyanogen, a Magenta, yellow) appeared so much, a picture will always be rubbed by the ablation presser foot stitch tongue 12. Since the toner image when being rubbed by the ablation presser foot stitch tongue 12 is still in a melting state, a picture will get damaged and will become what cannot bear use. This is not fundamental solution although thickness of paper is thick, that is, the waist of paper is strong, and this problem will not arise if it limits only to the paper which cannot coil around a fixing roll easily, in order to prevent this.

[0009] Moreover, in the conventional belt nip method, it was that to which the phenomenon of the approach of a belt, flapping of a belt, and the wrinkling of the recording paper tends to happen. According to the ununiformity of a belt circumference, the imbalance of right and left of a contact pressure with a fixing roll, etc., the front-face nature of the cylindricity of the roll with which the belt nip method is laying the belt and the ununiformity of the parallelism during a roll, and a further will shift crosswise, and will move. Therefore, a means to stop the movement of the cross direction of a belt within a certain amount of limits is required.

[0010] In order to solve this problem conventionally, the approach of a belt was controlled by detecting optically, mechanically, and electrically the movement of the cross direction of a belt, i.e., the approach of a belt, considering any one roll as a displacement roll among two or more rolls currently laid [firmly] across a belt, and making the shaft of both roll cross by considering others as a fixed roll. However, if a displacement roll is moved and the shaft is made to intersect the shaft of other fixed rolls, flapping will occur to a balance calyx gap of the tension of a belt, and a belt. Like especially this invention, when the belt was in contact with the hot fixing roll, the stress by heat became large and there were a wrinkling of a belt and a trouble that the phenomenon of breakage occurred.

[0011] The 1st purpose of this invention is offering the fixing equipment which solves the trouble of the picture injury at the time of ablation. The 2nd purpose of this invention is offering the fixing equipment of a new belt nip method applicable not only to monochrome picture but a color copying machine. The 3rd purpose of this invention has the thin thickness of paper in which a lot of toners appeared, and even when carrying out coloring fixing of the recording paper with the weak waist of paper, it is not needing an ablation presser foot stitch tongue, but offering the fixing equipment of a belt (this is called self stripping below) nip method which can exfoliate without using no ablation equipment at the outlet of a belt nip.

[0012] The 4th purpose of this invention is attaining the stable belt run and the reinforcement of a belt while offering the fixing equipment of the belt nip method which the approach of a belt, flapping of a belt, and the wrinkling of the recording paper do not produce. Furthermore, the 5th purpose of this invention is offering the fixing equipment of the belt nip method which can guarantee the stable picture which does not have a picture gap to various forms also to continuous-running conditions also to high-speed conditions.
[0013]
[Means for Solving the Problem] In the heat fixing forging-roll-die fixing equipment which is established in the non-established toner image on imprint material according to this invention 0.5mm The heat-resistant belt laid with the heat fixing roll with which the above elastic body was covered, and two or more support rolls is prepared. Only a predetermined angle twists a heat-resistant belt around the surroundings of a fixing roll so that a nip may be formed between this heat-resistant belt and the aforementioned fixing roll. The fixing equipment characterized by making the elastic body of the aforementioned heat fixing roll produce distortion is offered by arranging a pressure roll in the aforementioned heat-resistant belt inside at the outlet of the aforementioned nip, and carrying out the pressure welding of this pressure roll to the aforementioned heat fixing roll through a ****** heatproof belt.
[0014] The amount epsilon of distortion of the circumferencial direction of the elastic body of the aforementioned heat fixing roll may satisfy epsilon>=0.5% of relational expression. The aforementioned heat-resistant belt may be laid with at least three or more support rolls, the support roll of the others [one / of the support rolls of these] in a displacement roll may be constituted with a fixed roll, and this displacement roll may be constituted so that the roll axis of other fixed rolls may be intersected in the position of roll axis and it can move.
[0015] The medial axis of the aforementioned displacement roll may be constituted so that the medial axis of the two aforementioned fixed rolls located in the upstream and downstream near this displacement roll to the hand of cut of the aforementioned heat-resistant belt may be displaced along with ellipse tracing used as a focus. The aforementioned heat fixing roll may be constituted so that the heat-resistant belt and nip which were laid between two fixed rolls may be formed.
[0016] In the upstream of the aforementioned pressure roll of the nip field of the aforementioned heat fixing roll and a heat-resistant belt, you may form the elastic body roll which carries out a pressure welding to a heat fixing roll through this heat-resistant belt from the heat-resistant belt inside. Furthermore, according to this invention, the pressure welding of the heat-resistant belt laid with a heat fixing roll and two or more support rolls is carried out, a nip is formed, and the fixing equipment characterized by arranging the temperature sensor which detects the skin temperature of a heat fixing roll inside [heat-resistant belt] the aforementioned nip field is offered in the fixing equipment established in this nip field.
[0017] In order that fixing of a color picture may color a multilayer non-established toner image in the target color, considering that a lot of heat must be given to a toner, the belt nip method which can form a broad nip is suitable. The artificer discovered the following phenomena, while studying the method of carrying out self stripping also of the thin paper, i.e., the method of decreasing the adhesion force of a fixing roll and a melting toner.
[0018] It is the fact that the adhesion force of the interface of a melting toner and a fixing roll front face is greatly influenced by the fixing roll front face of distortion, without being decided only by both surface chemistry material physical-properties value. That is, when the surface distortion moves from the state where the melting toner touches the front face of the fixing roll which has surface distortion beforehand to the state where it is released momentarily, it is the phenomenon in which the adhesion force of a toner and a fixing roll front face decreases.
[0019] When heat-resistant elastic bodies, such as the material from which the front face of a fixing roll can carry out elastic deformation comparatively easily, and can specifically produce distortion according to the load from outside, for example, silicone rubber, and a fluororubber, are covered, it sets near the nip outlet. It is established, while the hard roll of a minor diameter carries out a pressure welding and receives distortion, and I hear that the adhesion force of the moment the

distortion makes it release at a nip outlet, a toner, and a fixing roll front face is reduced rapidly, and it is tended self stripping that it is carried out, and there is. This fact is proved still more clearly by the following model experiment. <Model experiment> Here, the adhesion force of a toner and a roll clarifies the fact of being influenced by the fixing roll front face of distortion, by the model experiment.
[0020] The fixing roll A (soft roll) covered by the thickness whose elastic body (Si rubber) is 2.0mm, and the fixing roll B (hard roll) with which 50 micrometers of Teflons were covered are adjusted to the temperature of 130 ** by each. 3. Force on the aforementioned fixing roll front face the toner side of the recording paper with which the color toner image of the amount of 0 mg/cm2 was imprinted for 10 seconds by pressure XKg/cm2. After that 500 mm/sec A toner and a roll interface are rapidly torn off at speed. A load required to tear off at this time is recorded through a load exchanger. The outline of an adhesion force detector and its equipment is shown in drawing 3 . As for a load transfer rod and 18, the portion on which 16 pastes up the tooth back of the recording paper 7, and 17 are [a load transducer and 19] recorders. The result obtained by such model experiment is shown in drawing 4 .
[0021] The force pulled apart, so that the load to force becomes large, when it is the fixing roll A with which the elastic body was covered by this becomes small, and a bird clapper understands at zero the force pulled apart above a certain load. However, with the fixing roll B (hard roll), it is hardly influenced of the load forced beforehand, but the force to pull apart is always fixed. The force to pull apart is equivalent to the adhesion force of the interface of a toner and a roll. In an elastic body roll (fixing roll A), adhesion force reduces adhesion force with increase of the forcing load of a toner, without being decided only a toner and qualitatively of roll facing. Although the mechanism of the adhesion force reduction by this forcing load increase is not understood clearly, artificers think as follows now.
[0022] If a pressure is applied, a front face will transform the soft roll with which the elastic body was covered, and after distortion has arisen, it is in contact with the toner. If a pressure is suddenly removed from this distortion state, distortion will be released and it will return to the original state. At this time, a micro slip is produced in the interface of a toner and a roll. It is the hypothesis that existence of this micro slip is the reduction effect of adhesion force. With the hard roll which does not deform a front face like the fixing roll B, since distortion does not arise, a micro slip cannot exist. For this reason, the adhesion force reduction effect does not show up. this invention applies this idea to a belt nip method.
[0023] Furthermore, in order to solve the 5th purpose of the above, according to this invention, the non-established toner image on imprint material is set to the established heat fixing forging-roll-die fixing equipment. 0.5mm The heat-resistant endless belt laid with the heat fixing roll with which the above elastic body was covered, and two or more support rolls is prepared. Only a predetermined angle twists an endless belt around the surroundings of a fixing roll so that a nip may be formed between this endless belt and the aforementioned fixing roll. By arranging a pressure roll in the aforementioned endless-belt inside at the outlet of the aforementioned nip, and carrying out the pressure welding of this pressure roll to the aforementioned heat fixing roll through the aforementioned belt It is made to make the elastic body of the aforementioned heat fixing roll produce distortion, the aforementioned fixing roll is driven, and the fixing equipment characterized by considering an endless belt as a follower is offered.
[0024] This invention persons found out improving a trouble sharply by improving the following three points, as a result of making a research effort wholeheartedly for realization of fixing equipment without a picture gap. Conventionally, although one of the improving point of the was driving the drive system by the roll group which lays a belt, it can obtain the quality of image by which the direction which adopted the method which carries out the direct drive of the fixing roll was stabilized most.
[0025] namely, the method of driving ** fixing roll as a method of driving the whole fixing equipment, the method of driving ** endless, and ** -- although three of methods which drives both can be considered, the quality of image stabilized most is obtained by the method which drives the fixing roll of ** among these methods The 2nd of improving points is to have specified the front-face nature of an endless

belt. That is, conventionally, as an endless-belt material, although the polyimide film of 75-micrometer ** and the Teflon film containing strengthening study fiber were used, it became clear that a picture gap has many which have still smaller coefficient of friction with a form as a surface characteristic. As for a coefficient of static friction mu, according to it, 0.30 or less are [0.40 or less] more preferably effective to a picture gap. This slides a form rear face and an endless-belt side intentionally, and it is made not to produce a skid in a form front-face side with a fixing roll and toner fine particles. (As for the coefficient of static friction of a fixing roll and paper, 0.8 or more are desirable.) Viscosity [in / the 25 degrees C / it is expressed with the following general formula (1) which was excellent in especially wettability to the endless belt made from a polyimide although the 3rd of improving points was using conventionally the silicone oil which consists of dimethylpolysiloxane as a release agent supplied to a fixing roll, and] is 10-100,000cs. It is effective to use the amino denaturation silicone oil which has an amino group.
[0026]
[Equation 2]

[0027] The inside of [, however a formula and A are -R'-X (are here and R' shows the alkylene machine of carbon numbers 1-8). X -NH2 Or -NH(CH2)2NH2 being shown -- it expresses -- having -- b And c]
 which is 0< b<=10 and 10<=c<=1000, respectively -- this reason Although it does not understand clearly, to imido combination of the polyimide film which is a base film, the amino group in an amino conversion silicone oil works effectively, and it is considered because the wettability of the oil of a polyimide film plane is improved. That is, by applying the amino denaturation silicone oil supplied to a polyimide film front face by being transmitted in a fixing roll front face, the skid of a form rear face and an endless belt is enlarged, and a picture gap is prevented.
[0028] It is -(CH2)3NH2 as A preferably among the amino denaturation silicone oils to be used. Or -(CH2)3NH(CH2)2NH2 Are suitable. b as the concentration and c preferably, respectively 0.01< b<1 and 50<=c<=300 -- more -- desirable -- 0.02<=b<=0.5 And 100<=c<=200 The oil of 100 - 400 cs is preferably [as viscosity of oil] suitable more preferably 50 to 1000 cs.
[0029] Moreover, when it was said that a double-sided copy is taken as copy mode when this amino denaturation silicone oil is used especially, it became clear not to degrade the toner image established at once. On the other hand, when dimethyl oil was used and a double-sided copy was taken, the toner picture established at once might have become coarse. It seems that these differences are influenced to the surface mold-release characteristic by the difference in the compatibility which a functional group brings about.
[0030] These three improving points are matters which are uniquely effective, respectively, and the trouble of a picture gap is minimum-ized by using together. Moreover, the thought common to these three improving points aims at the incongruent dissolution of the fixing roll surface speed which was made to produce a skid intentionally rather between the rear face of a form, and the upper surface of an endless belt in order to prevent a picture gap, and produced distortion, and the surface speed of an endless belt.
[0031]
[Example] Drawing 5 shows one example of the belt nip method for attaining this invention.
It becomes a prerequisite to use the so-called soft roll with which the elastic body was covered by the front face of a metal core as a <example 1> fixing roll. The endless belt laid by the fixing roll (soft roll) with two or more rolls is contacted, a belt nip is formed, and the pressure welding of the pressure roll is carried out to a fixing roll through a belt at the nip outlet. At this time, elastic deformation of the front face of a fixing roll is carried out, and distortion is given to the front face. This pressure roll has the function to make a fixing roll front face produce distortion. It is more desirable for the front face of a pressure roll to be hard in a minor diameter from a fixing roll, in order to give distortion of a fixing roll efficiently by the low load.
[0032] this invention is explained in more detail using an example 1. The fixing equipment used in the example 1 is shown in drawing 5 . It was covered with the

thickness whose HTV silicone rubber (45 rubber degrees of hardness) is 2mm as a ground layer 20 by the hollow roll 3 which changes with an aluminum cylinder with an outer diameter [of 46mm], and a bore of 40mm, and the fixing roll 1 is 50 micrometers about silicon RTV rubber as a topcoat layer 21 to the front face further. A DIP coat is carried out to thickness and the front face near a mirror-plane state is made. As a source of heating, the halogen lamp 5 of 400W is formed in the interior, and the front face of the fixing roll 1 is adjusted by 150 ** by the temperature controller (not shown) through a temperature sensor 6. Moreover, it is dimethyl silicone oil viscosity 300cs (product made from KS-96:Shin-etsu chemistry) as a release agent. It is uniformly supplied by the oil distribution system 9. On the other hand, an endless belt 15 is the thickness of 75 micrometers. 300mm and circumference of 288mm It is a POIRIMIDO film and is laid by the tension of 10kg with four rolls 22, 23, 24, and 25 made from stainless steel. Each diameter is 22, 20, and 20 or 18mm. The roll 25 (pressure roll) with a diameter of 18mm is energized toward the center of the fixing roll 1 by the compression coil spring 26 as a pressurization means, and is sticking the belt 15 to the fixing roll 1 by pressure. The belt contact angle to the fixing roll 1 is 45 degrees, and the width of face of a belt nip is set to 19.6mm at this time. Since, as for the outlet of a belt nip, the pressure roll 25 is stuck by pressure through the belt, the elastic body of a fixing roll deforms and distortion generates it in the front face. The driving force from a motor 27 is transmitted to the drive roll 22 with a diameter of 22mm, and a belt and a fixing roll are 250 mm/sec to the direction of an arrow 28. Follower rotation is carried out at speed.

[0033] Color toners are 3.0 mg/cm2 on the paper of various weights (thickness) to this fixing equipment. The result which investigated self stripping nature [in / through and a nip outlet / for the non-established toner image imprinted by density] is shown in drawing 6 . Feed-direction A of paper is the case where it sends so that the fiber of paper may become a fixing roll and parallel, in this drawing, and feed-direction B is a perpendicular case. The case of feed-direction A is in the inclination which self stripping cannot carry out easily with the thickness of paper with it on the structure of paper. [the weak waist of paper, and] [same] the pressure roll load is increased from the above data -- it is alike, and it follows and a bird clapper also understands paper with a small (thickness of paper -- thin) weight as self stripping being possible

<Example 1 of comparison> The case where a fixing roll is a hard roll here is described. It investigated about the self stripping nature at the time of changing only a fixing roll into the fixing roll B (hard roll) with which 50 micrometers of Teflons were coated from the fixing roll A of silicon (soft roll) on the same conditions as an example 1. Consequently, as shown in drawing 7 , in all pressure roll loads, self stripping was impossible.

The surface distortion of the elastic body roll in the load <measurement of distortion> Existing can be surveyed as follows. When a pressure welding is carried out under the load which generally has a hard roll and a soft roll, elastic deformation of the soft roll front face is carried out in a nip field, and there is a circumferencial direction of the front face, it is distorted, and produces epsilon. If a roll pair is rotated in this state and the recording paper passes through a nip field, the recording paper will be conveyed in the nip field which produced distortion. For this reason, as for the length of the recording paper sent out by the elastic body roll 1 rotation which produced distortion, the amount of conveyances actually becomes large by circumferencial direction distortion epsilon from the length of a roll circumference.

[0034] That is, it will be called epsilon={(length of the recording paper sent out by elastic body roll 1 rotation)/(circumference of elastic body roll at time of epsilon= 0)}-1. Survey of actual distortion epsilon is attained from this method. The distortion by this invention is the value of this measuring method. The load in an example 1 and the relation of distortion are shown in drawing 8 . This is distorted, the self stripping of the paper of the direction delivery of B of the weight of 90 g/m2 becomes possible from 0.5%, and it exfoliates most from 2.5% of distortion, and is ****** thin paper (55 g/m2). The self stripping of the direction of A becomes possible.

[0035] The reduction effect of the adhesion force of a toner and a fixing roll interface by release of distortion in a nip outlet is applicable not only to a belt nip method but a roll nip method. In this case, the one [equivalent to a pressure

roll or] softer than it tends to produce distortion of a fixing roll, and tends [that much] to carry out self stripping of the surface hardness of a fixing roll. In fixing equipment equivalent to the <example 2 of comparison> example 1, a relation with a load is described about the self stripping nature of the method (that is, roll nip method) which removes belt equipment, instead prepares a pressure roll, and forms a nip with a fixing roll.
[0036] The pressure roll used here is the 50mm as a fixing roll with the same diameter, and, as for the front face, 50-micrometer Teflon coating is carried out. It is adjusted by 160 ** and the skin temperatures of both rolls are the non-established toner image same between roll nips as an example 120 mm/sec Through and the self stripping nature at that time were investigated at fixing speed. The result is shown in drawing 9 . Moreover, the load of this fixing equipment and the relation of surface distortion are shown in drawing 10 . In the case of a roll nip method, the self stripping of the paper of the direction delivery of B of a two or more 90 g/m weight becomes possible from 1.0% of distortion, it exfoliates most from 5% of distortion, and the self stripping of the paper of the direction delivery of A of ****** thin paper (55 g/m2) becomes possible. A thing [values / these / the belt nip method in this invention] is shown in drawing 11 .
[0037] A belt nip method can perform self stripping in a distortion smaller than a roll nip method so that it may understand from now on. Since distortion is momentarily given near the outlet of a belt nip by the belt nip method as this reason, a small distortion also has the large rate of change of distortion, and is considered to be easy to generate a micro slip in the part, a toner, and a fixing roll interface.
[0038] Moreover, 80kg or more is required for the total load of a belt nip method to being 10-20kg in a roll nip method. By the belt nip method, a sharp load fall can be realized and, for this reason, reduction of the driving torque of the surface wear equipment of a fixing roll is attained. Moreover, the part roll rigidity with few loads is small, ends, and can attain thinning with thick diameter of a roll and roll core.
[0039] Although both rolls needed to be made to estrange and deformation of a fixing roll needed to be prevented by the conventional roll nip method further again at the time of being un-established, the need does not exist with this equipment and simplification of equipment is attained. Application to the fixing equipment for a long roll, for example, large drawings, is also attained further again. Generally, as for rubber, thermal conductivity acts as a heat insulator thermally small. The thickness of rubber has the thinner one if possible good for stabilization of the temperature of a fixing roll. By the conventional roll nip method, for obtaining latus nip width of face, thickness of the rubber of a fixing roll had to be thickened, and there was a limitation in the thinning of rubber. However, since a nip is formed with a belt, it is not necessary to thicken rubber **, and as for rubber, by the belt nip method of this invention, distortion which can carry out self stripping should just have even the thickness which can be formed uniformly. Thus, a belt nip method has the feature that nip width of face and distortion can be changed independently, respectively.
[0040] Specifically, by the conventional roll nip method, at least 2mm or more, although the elastic body 3.0mm or more was desirably required, by this invention, it has the advantage in stabilization of temperature, and shortening of a warm uptime 0.5mm or more that there should just be 1.0mm or more desirably. Although the ablation presser foot stitch tongue was used for the pressure roll and coiling round of the paper to a pressure roll was prevented by the conventional roll nip method, it is possible to make the curvature of the belt in the ablation position of the paper from a belt into the size around which paper does not coil by this belt nip method. It has the advantage in which a fixing roll and a belt do not need an ablation presser foot stitch tongue. Thereby, the injury on the roll by the ablation presser foot stitch tongue and a belt and the release agent scratched by the ablation presser foot stitch tongue accumulate at the nose of cam of a presser foot stitch tongue, it transfers at the nose of cam of paper, and the trouble of the conventional roll nip method that the stain of a release agent occurs can also be solved.
Conventionally [<example 2>], there is a problem of the rolling defect by the temperature sensor, and this had caused the short-lived nature of a roll, and quality-of-image degradation. With the elastic body roll with which the elastic body

was covered by especially the front face, this influence was large. In this invention, as shown in drawing 12 , a temperature sensor 6 is allotted to a belt inside, and it becomes possible by detecting the temperature of the fixing roll in a belt nip through a belt to carry out a temperature control. For this reason, the problem of the injury by the sensor is solved completely.
When the load of a pressure roll was changed using the belt nip method fixing equipment of the <example 3> example 1 and the fixing experiment was conducted, by the belt nip method of this invention, it found out that there was a problem of a new quality-of-image defect. It is the phenomenon in which a picture will shift beyond from a certain load, when the load of a pressure roll is increased (this phenomenon does not happen by the belt nip method which used the hard roll in the example 1 of comparison.). The result which investigated the relation between a picture gap and a load is shown in drawing 13 . Artificers considered this mechanism as follows.
[0041] Generally, the surface velocity of an elastic body roll is the surface velocity Vs of a there, when [that] it is distorted, and is influenced of epsilon and elastic body circumferencial direction distortion epsilon exists. It is set to Vs =(1+epsilon) V. V shows the surface velocity in epsilon= 0. By the belt nip method of this invention, the load from a pressure roll is received at a nip outlet, and circumferencial direction distortion epsilon exists. And speed Vs of the place As for the speed V with the nip field of only a belt (here, it is epsilon**0), the speed difference exists slightly. thus, the paper which will have been stuck to the roll front face if it becomes larger than a value with the speed difference when a difference exists in roll surface velocity within a belt nip -- just -- being alike -- it is the hypothesis that it becomes impossible to absorb the speed difference, and a picture gap arises Self stripping is possible and the range of distortion which a picture gap does not produce is 0 - 3.75%. In order to solve the problem of this picture gap, artificers found out the following solution method according to the aforementioned hypothesis.
[0042] Since the gap resulting from the speed difference is held down as much as possible, it is a method using the pressure auxiliary roll 29 covered with the soft elastic body by the upstream of a pressure roll. (Refer to drawing 14) This pressure auxiliary roll is a roll for preventing that stick a belt on a fixing roll from a belt inside, and the front face of a belt and a fixing roll shifts. In the example 2, the pressure welding of the elastic body roll which covered Si rubber firing object (the rubber degree of hardness of 23 degrees / ASUKA C type hardness meter) with a thickness of 6mm was carried out to the stainless steel core with a diameter of 6mm by 4kg of loads at the place of 11mm of upstreams of the pressure roll of the fixing equipment of an example 1. As a picture gap was shown in drawing 15 at this time, while about 10kg increase in a load was attained as compared with the case where there is no pressure auxiliary roll 29 and the part self stripping nature improved, improvement in fixing nature was also obtained. Moreover, by adoption of this pressure auxiliary roll, even if it decreases belt tension, since the fixing force of a belt and a roll does not decline, the advantage in which the life of a belt can be increased also has it.
[0043] Furthermore, in order to solve the problem of the approach of a belt, artificers came to know the following fact, as a result of studying the firm-bridging method of a belt, and the displacement method of a displacement roll. This fact is explained using drawing 16 . Drawing 16 shows the case where the belt is laid with three rolls. First, a belt is laid with at least three or more rolls, the 1st fact considers any one of them as the displacement roll 23, more than other two or they are considered as the fixed rolls 24 and 25, and, as for a belt nip, it is very effective to carry out between fixed rolls. When the shaft of the displacement roll 23 is made to intersect the shaft of the fixed rolls 24 and 25, since a belt is twisted compulsorily, flapping generates it in the upstream and downstream of a displacement roll. However, this flapping will be regulated with the neighboring fixed rolls 24 and 25, flapping of most belt sides laid between fixed rolls will be lost, and a belt will maintain a flat surface. This is because a fixed roll is an parallel relation mutually. By forming a belt nip at this flat surface, it becomes possible to suppress flapping of a belt with a fixing roll, a wrinkling, and breakage to the minimum. Moreover, when the recording paper was conveyed to this belt nip, it became clear that there is also no wrinkling of the recording paper and there is also no disorder of a picture.

[0044] As a result of inquiring about the displacement method of the shaft of a displacement roll furthermore, it came to acquire the 2nd fact. it -- a variation rate -- the end of the shaft of a roll -- the hand of cut of a belt -- receiving -- a variation rate -- when the variation rate of the medial axes A and B of two fixed rolls, the upstream near a roll and a downstream, 24 and 25 was carried out along with the elliptical orbit 30 used as a focus, there was least stress of a belt, for this reason, it lenticulated, and it became clear to also suppress a wrinkling and breakage to the minimum And the force required to carry out the variation rate of the displacement roll in this case is small, it ends, and the miniaturization of displacement equipment is attained. this -- a variation rate -- the case where roll axis are changed along with an elliptical orbit 30 -- a variation rate -- the circumference of a next belt -- a variation rate -- in order not to change with a front -- it is -- a variation rate -- it is order and is because the tension of a belt does not change

[0045] The approach amendment mechanism of the belt by this method is explained using drawing 17 . When approach occurs in one of right and left of a belt, the light of the photosensor 31 with which the belt was prepared in the belt edge on either side is interrupted, and it is detected in which the approach occurred. When a belt approaches a near side in drawing 17 and a photosensor detects the approach of the belt, a signal is sent to a stepping motor 32, the amount rotation of conventions of the stepping motor is carried out, and the variation rate of the position of the shaft of the near side of a displacement roll is made to carry out in the direction of D. The guide 33 is formed so that the bearing of the displacement roll 23 can displace A and B along with the elliptical orbit 30 used as a focus at this time. Thereby, a belt 15 begins to approach an opposite side with a near side, and the position of a belt is amended.

The <example 4> fixing roll 1 was covered with the so-called soft roll with which the elastic body was covered by the front face of a metal core by the with an outer-diameter bore [40mm bore of 46mm] aluminum cylinder 3 as a ground layer at the thickness whose HTV silicone rubber 20 (rubber degree of hardness of 45 degrees) is 2mm, further, as a topcoat layer, it carries out the coat of the silicon RTV rubber 21 to the thickness of 50 micrometers, and the front face is made to it by the As a source of heating, the halogen lamp 5 of 400 W is formed in the interior, a skin temperature is detected by the temperature sensor 6, and it is controlled by the temperature controller which is not illustrated by the constant temperature of 150 **.

[0046] Moreover, as a release agent, it is -(CH2)3NH2 as a functional group. The product made from amino denaturation silicone oil (oil viscosity 300cs) Shin-etsu chemistry which it has, b= 0.1, and c= 130 (X-21-7763G) are uniformly supplied by the oil distribution system 9. On the other hand, an endless belt 15 is the thickness of 75 micrometers, a coefficient of static friction 0.40, width of face of 300mm, and this length of 288mm. It is a polyimide film and they are the rolls 22 and 20 made from stainless steel of four, and 20 or 18mm. The roll 25 (pressure roll) with a diameter of 18mm is energized by 25kg as the total load toward the center of the fixing roll 1 by the compression coil spring 26 as a pressurization means, and is sticking the belt 15 to the fixing roller by pressure. Contact of the belt to a fixing roll is 45 degrees as a contact angle, and serves as width of face of 19.6mm of the belt nip at this time. Since, as for the outlet of a belt nip, the pressure welding of the pressure roll 25 is carried out through the belt, the elastic body of a fixing roll deforms and distortion generates it in the front face. The driving force from a motor 27 is transmitted to the fixing roll 1, and follower rotation of the belt can be carried out at the rate of 200-350mm / sec in the direction of an arrow 28 with a fixing roll.

[0047] this fixing equipment -- using it -- the form top of A4 [various] size -- a color toner -- 2.5 mg/cm2 the non-established solid picture imprinted by density -- fixing speed 250 mm/sec from -- 350 mm/sec It processed. At this time, the setting temperature of a fixing roll was changed with 150 **, 165 **, and 180 **, respectively, operated by 20-sheet continuation, and evaluated those picture gaps. Consequently, it is 350 mm/sec as shown in Table 1. It turns out that supply [like] of oil further called 20-sheet continuous running even if it also sets at high speed and is a smooth form like double-sided coat paper does not catch up, and generating of a picture gap takes place to the bottom of a few condition under [no] conditions.

[0048]
[Table 1]

[0049] As a <example 5> release agent, it is -(CH2)3NH(CH2)2NH2 about the kind of amino group to be used. Although the completely same test as an example 4 was carried out by the amino denaturation silicone oil (product X-21-7720 made from the Shin-etsu chemistry) which carried out and made other conditions the same, the same test result was completely obtained.
When other conditions were made the same as examples 4 and 5 and were tested using the dimethylpolysiloxane oil (KTmade from Shin-etsu chemistry- 96,360 cs) which does not have the conventional amino group in the oil used as a <example 6> release agent, the result of a picture gap was a permissible level although the picture gap was shown a little in the second half of continuous running at the time of high speed as shown in Table 2.
[0050]
[Table 2]

[0051] It is same functional-group-(CH2)3NH2 as an example 1 about the oil used as a <example 7> release agent. It considers as the amino denaturation silicone oil (the product made from the Shin-etsu chemistry, b= 0.1, c= 130, X-21-7763G) which it has, and is coefficient of friction of the endless film of a polyimide 0.5 It was made what was adjusted and also considered as the same conditions as an example 4. This result was completely the same as that of an example 4.
a <example 8> release agent -- an example 5 -- the same -- as the amino group -(CH2)3NH(CH2)2NH2 it is -- and also it changes into an amino denaturation silicone oil (made from the Shin-etsu chemistry X-21 -7720) -- an example 7 -- the same -- coefficient of friction of an endless belt -- 0.5 Even if tested, the result was completely the same as the example 7.
When the dimethylpolysiloxane oil (KFmade from Shin-etsu chemistry- 96,300 cs) which does not have the amino group which was being used conventionally as a <example 3 of comparison> release agent was used, the completely same test as examples 7 and 8 was performed and it became 15 - 20 sheets in the second half of continuous running as shown in Table 3, it turns out that it is easier to generate a picture gap at the time of high speed. This invention persons reasoned that this result was what is depended on the wettability of the oil to a polyimide film, or compatibility. That is, the amino group is affinitive from a methyl group to the imido basis of a polyimide film, and it reasoned whether to have adhered to the bottom of a condition whose oil supply like continuous running decreases effectively.
[0052]
[Table 3]

[0053] What was made into the coefficient of static friction 0.30 among the front-face nature of a <example 9> endless belt was used, and also it tested on an example 4 and these conditions. in addition, measurement of a coefficient of static friction -- New East Chemistry tabulation side measurement machine -- HEIDON-14 Type is used and the coefficient of static friction (normal force of 200g) to L paper (64 g/m2, Fuji Xerox make) is measured. This result did not have a method of the complaint beginning, either, and there was no picture gap and they were an example 4 and more than equivalent. This result is shown in Table 4.
[0054]
[Table 4]

[0055] It is coefficient of friction 0.3 as front-face nature of an endless belt like the <example 4 of comparison> example 9. When tested using the dimethylpolysiloxane which uses a thing and does not have a functional group as a release agent, a result as shown in Table 5 was brought. Although some inclinations to deteriorate at the time of continuous running at the time of high speed were seen, they were a permissible level.

[0056]
[Table 5]

[0057] It is the method of using what was made into coefficient of friction 0.40 of an endless belt like the <example 5 of comparison> example 6, driving only the fixing roll 1 by the ** motor 27 as the drive method of the whole fixing equipment shortly, and making others following.
** It is the method of driving the roll 22 which lays an endless belt by the motor 28 which is not illustrated, making an endless belt driving, and making the fixing roll 1 following.
How to make both ** ****s a driving source.
The comparison test by the drive method of three ** was performed. The result is shown in Table 6.
[0058]
[Table 6]

[0059] As the drive method of fixing equipment, this result showed that the method of driving the fixing roll of ** was the best drive method to a picture gap.
[0060]
[Effect of the Invention] this invention makes self stripping possible by generating distortion on a fixing roll front face in the fixing equipment of the conventional belt nip method by carrying out the pressure welding of the pressure roll to a fixing roll through a belt at a belt nip outlet so that clearly from the above explanation. For this reason, it becomes applicable to the fixing equipment of colors other than monochrome fixing equipment. Moreover, by introducing flapping of the belt which was the fault of the conventional belt nip method, a wrinkling, and the approach amendment mechanism of the firm-bridging method of a belt, and a belt in which breakage is also suppressed to the minimum, it became possible to prolong the life of a belt sharply, and it became possible to prevent the wrinkling of the recording paper, and disorder of a picture. Moreover, even if it compares the belt nip method of this invention with a roll nip method, it has many advantages, such as high speed, high reliance, and high definition, and the utility value is very large on industry.
[0061] Furthermore, there was no problem of picture ****** by the ablation presser foot stitch tongue whose this invention is the fault of the conventional belt nip formula, and it became possible under the high-speed condition to realize the quality of image which does not have a picture gap in the bottom of a continuous-running condition at the various bottoms of a form condition. Moreover, even if it compares this belt nip method with 11 pairs of roll nip methods by which roll pair-twinning composition is carried out, it has many advantages, such as high speed, high reliance, and high definition, and the utility value on industry is very large.

[Translation done.]

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(54) NAME OF INVENTION: Fixing device

(57) ABSTRACT
PURPOSE: To provide a fixing device, which solves a problem of damaged images when paper material is ejected.

STRUCTURE: A fixing device, which fixes unfixed toner images on copying material with a thermal fixing roller, and which has the following structure. [Note: see figure on original document, page 1]

- A thermal fixing roller (1), which is covered with elastic materials more than 0.5 mm thick (20, 21).

- A heat resistant belt (15), which is stretched between several supporting rollers (22, 23, 24) and the thermal fixing roller (1). In order to make a nip between the heat resistant belt and the fixing roller, part of the belt is pressed on the fixing roller from a specific angle.

- A pressure roller (25), which is installed under the heat resistant belt at the exit point of the nip.

Thanks to the pressure roller, which presses the thermal fixing roller through the heat resistant belt, the elastic material around the thermal fixing roller is deformed.

The deformation rate, in the circulating direction, of elastic materials (20, 21) around the thermal fixing roller (1) can be more than 0.5 %.

The thermal fixing roller can be the main drive. The heat resistant belt is driven by the roller.

Static friction coefficient by the heat resistant belt can be less than 0.40.

Amino denatured silicon oil can be applied to the thermal fixing roller as a releasing agent.

CLAIMS
CLAIM 1: A fixing device, which fixes unfixed toner images on copying material with a thermal fixing roller, and which has the following structure.

- A thermal fixing roller, which is covered with elastic materials more than 0.5 mm thick.

- A heat resistant belt, which is stretched between several supporting rollers and the thermal fixing roller. In order to make a nip between the heat resistant belt and the fixing roller, part of the belt is pressed on the fixing roller from a specific angle.

- A pressure roller, which is installed under the heat resistant belt at the exit point of the nip.

Thanks to the pressure roller, which presses the thermal fixing roller through the heat resistant belt, the elastic material around the thermal fixing roller is deformed.

CLAIM 2: According to the fixing device described in Claim 1, deformation amount ε, in the circulating direction, of elastic material around the thermal fixing roller has to respect the following formula.
$\varepsilon \geqq 0.5$ %.

CLAIM 3: According to the fixing device described in Claim 1, the heat resistant belt is stretched between at least three supporting rollers. The supporting rollers consist of one displacement roller and two or more fixing rollers. The displacement roller's axis can be displaced in a crosswise direction against the other two fixing rollers' axes.

CLAIM 4: According to the fixing device described in Claim 3, the axis of the displacement roller is displaced along an elliptical orbit, which is formed by the focal points of the two supporting rollers' axes. One supporting roller, which is installed upstream in the belt circulating direction, is closer to the displacement roller than the other supporting roller, which is installed downstream in the belt circulating direction.

CLAIM 5: According to the fixing device described in Claim 3, there is a nip formed at the contacting part of the thermal fixing roller and the heat resistant belt stretched between the two supporting rollers.

CLAIM 6: According to the fixing device described in Claim 1, an elastic roller, which presses the pressure roller from under the heat resistant roller, is installed upstream (in the belt circulating direction) of the pressure roller in the nip area.

CLAIM 7: According to the fixing device, in which the thermal fixing roller presses the heat resistant belt stretched between some supporting rollers, the nip is formed at the contacting part of the roller and the belt. Image fixing is operated at this nip area. A temperature sensor is installed in the nip area to detect the thermal fixing roller's surface temperature through the heat resistant belt.

CLAIM 8: The fixing device, which fixes unfixed toner images on copying material with a thermal fixing roller, and which has the following structure.

- A thermal fixing roller, which is covered with elastic materials more than 0.5 mm thick.

- A heat resistant endless belt, which is stretched between several supporting rollers and the thermal fixing roller. In order to make a nip between the heat resistant endless belt and the fixing roller, part of the belt is pressed on the fixing roller from a specific angle.

- A pressure roller, which is installed under the heat resistant belt at the exit point of the nip.

Thanks to the pressure roller, which presses the thermal fixing roller through the heat resistant belt, the elastic material around the thermal fixing roller is deformed.

The thermal fixing roller can be the main drive. The heat resistant belt is driven the roller.

CLAIM 9: According to the fixing device described in Claim 8, static friction coefficient of the heat resistant endless belt can be less than 0.40.

CLAIM 10: According to the fixing device described in Claim 8, amino denatured silicon oil, which is shown by the following formula (1) and which adhesive power is 10~100,000cs, is applied to the thermal fixing roller as a releasing agent. However, A stands for -R' -X (R' means

alkylene group of carbon number 1 to 8 and X means -NH_2 or –NH $(CH_2)_2$ NH_2 in this formula). *b* and *c* stand respectively for $0<b\leqq 10$ and $10\leqq c\leqq 1000$.
[Note: see formula on page 2 of the original document]

DETAILED DESCRIPTION

0001

INDUSTRIAL APPLICATION: Belonging to the field of Information recorders, such as copy machines, printers and facsimiles, this invention concerns a fixing device equipped with a heat roller, especially a belt nip typed fixing device, which fixes unfixed toner images on copy paper by heat.

0002

CONVENTIONAL TECHNOLOGY: In the conventional fixing device, shown in diagram 1, heat pressure roller typed fixing devices (so called roll nip method) are generally adopted. With this type of fixing device, an unfixed toner image is inserted into the pressing area between a pair of heated rollers and then the image is fixed.

In diagram 1, 1 and 2 represent respectively the *fixing roller* and the *pressure roller. Fixing roller 1* consists of *metallic hollow roller 3*, which is made of, for example, high heat transmission rate aluminum. *Metallic hollow roller 3*'s surface is covered with *covering layer 4* made of Teflon (trademark of DuPont Co Ltd.), which is heat resistant and can easily be removed.

Halogen lamp 5 is installed inside of *metallic hollow roller 3. Temperature sensor 6*, which is installed on the *fixing roller*'s surface, sends signals to the temperature control circuit. For this purpose, *halogen lamp 5* is switched in order to keep a specific temperature.

Part of *unfixed toner 8*, on *copy paper 7*, could remain attached on *fixing roller 1* at the time of fixing (so called offset). In order to prevent this, *oil supply device 9* is installed in order to apply a specific amount of silicon oil on *fixing roller 1*'s surface.

0003: *Pressure roller 2* consists of *metallic core 10*, which is covered with thick *heat resistant elastic material 11*, such as silicon rubber. By elastic deformation of *heat resistant elastic material 11*, a pressed area (so called nip) is formed. Unfixed toner image is inserted into this nip area and then the image is fixed by pressure and heat energy action. *Copy paper 7*, which is ejected from the nip area, is twined around the *fixing roller 1* because of ink adhesive power. *Separator 12* is installed to separate the paper from the roller.

0004: Therefore, when high speed fixing is operated with the fixing device above, the toner and the paper require the same amount of heat energy and pressure at the same time. That means the nip width has to be extended in accordance with the fixing speed. For extending the nip width, the following solutions can be implemented:

1. The load between two rollers is increased.
2. The elastic material is thickened.
3. The roller's circumference is enlarged.

0005: With solutions 1 and 2 above, there are problems such as: nip width's unevenness along the roller axis because of paper slackness, uneven fixing or paper wrinkling. With solution 3, the quality problems mentioned above do not occur, but the device would be enlarged and it takes time to warm up from the room temperature to the fixing temperature (so called warm up time).

0006: To solve the problems mentioned above and to attain a high speed fixing operation, there is a method with a belt (so called belt nip method) shown in diagram 2. This method is shown in Open Patent Journal 61- 132972.

The belt nip method, shown in diagram 2, consists of:

- Several *supporting rollers* (two rollers here) *13 and 14*,
- *Endless belt 15*, which is stretched and is rotated between *supporting rollers 13 and 14*,
- *Fixing roller 1*, which forms the belt nip at the contacting area with *endless belt 15*.

When *paper 7*, on which unfixed *toner image 8* is fixed, passes between *fixing roller 1* and belt nip, the image is fixed by the pressure and the heat energy. *Paper 7* is removed by *separator 12* from the roller and is then ejected outside of the fixing device.

With this structure, the extension of the belt nip width between *endless belt 15* and *fixing roller 1* is easier than with the conventional belt nip method. Thanks to this, it is possible to attain high speed fixing operation and, moreover, the fixing roller can be smaller than the roll nip typed fixing device with the same fixing speed.

0007
PROBLEMS TO BE SOLVED BY THIS INVENTION: However, with the belt nip typed fixing device described above, *separator 12* must be installed behind the belt nip for paper separation. Paper, on which toner image is fixed, is twined around the roller between the belt nip exit and *separator 12*. The paper is forced to separate from the roller by *separator 12*.

When the edge of the paper, on which a normal image (for example a black and white image) is laid, is separated by *separator 12*, following paper sheets are detached without force by the paper's own strength. In other words, it is not difficult to separate paper from the roller.

0008
When the edge of paper, on which a large amount of three toners (cyan, magenta, yellow) is laid, is separated by *separator 12*, following paper sheets are difficult to detach because the toner has to be well heated when coloring and fixing a color image. As a result, *separator 12* scratches images all the time and the image quality becomes inferior. Only when using thick paper, in other words paper with strength, can paper twining be prevented. Therefore, this does not solve the fundamental problem.

0009
With the conventional belt nip method, problems such as belt tilting, belt ripples or wrinkled paper might happen easily. Moreover the belt slides sideways due to the following reasons:

- Uneven surface quality according to rollers' cylindricality (because the belt is stretched between two rollers),
- Uneven parallelism between rollers,
- Uneven belt circumference length,
- Uneven pressure in right and left side from the fixing roller.

Because of these reasons, the belt slip has to be minimal.

0010
To solve this conventional problem, belt sliding in a sideways direction, in other words belt tilting, is detected by optical method, mechanical method, and electrical method. In order to stretch the belt, one of the rollers is established as a displacement roller and others are established as supporting rollers. Belt tilting is controlled thanks to these two sorts of rollers, which are placed in a crosswise direction.

0011
The first purpose of this invention is to provide a fixing device which solves the scratched image problem when papers are separating. The second purpose is to provide a belt nip typed fixing device, which applies not only to black and white image but also to color image copy machines. The third purpose of this invention is to provide a fixing device without a separator or any other separating devices around the nip exit when thin papers, on which a large amount of toner is laid, are fixed (so called self stripping).

0012
The fourth purpose of this invention is to provide a belt nip typed fixing device which does not encounter problems such as belt tilting, belt ripples and wrinkled copy paper. At the same time, belt's stable operation and longer lasting life will be attained.

The fifth purpose of this invention is to provide a belt nip typed fixing device, which guarantees stable image quality without overlapping during high speed fixing operation, during continuous operation and with any kind of paper.

0013
MEANS TO SOLVE THE PROBLEM: With this invention, a fixing device, which fixes unfixed toner images on copying material with a thermal fixing roller, and which has the following structure can be provided.

- A thermal fixing roller, which is covered with elastic materials more than 0.5 mm thick.

- A heat resistant belt, which is stretched between several supporting rollers and the thermal fixing roller. In order to make a nip between the heat resistant belt and the fixing roller, part of the belt is pressed on the fixing roller from a specific angle.

- A pressure roller, which is installed under the heat resistant belt at the exit point of the nip.

Thanks to the pressure roller, which presses the thermal fixing roller through the heat resistant belt, the elastic material around the thermal fixing roller is deformed.

0014
Deformation amount ε, in the circulating direction, of elastic material around the thermal fixing roller has to respect the following formula $\varepsilon \geqq 0.5$ %. The heat resistant belt is stretched between at least three supporting rollers. The supporting rollers consist of one displacement roller and two or more fixing rollers. The displacement roller's axis can be displaced in a crosswise direction against the other two fixing rollers' axes.

0015
The axis of the displacement roller is displaced along an elliptical orbit, which is formed by the focal points of the two supporting rollers' axes. One supporting roller, which is installed upstream in the belt circulating direction, is closer to the displacement roller than the other supporting roller, which is installed downstream in the belt circulating direction. There is a nip formed at the contacting part of the thermal fixing roller and the heat resistant belt stretched between the two supporting rollers.

0016
An elastic roller, which presses the pressure roller from under the heat resistant roller, is installed upstream (in the belt circulating direction) of the pressure roller in the nip area. According to the fixing device, in which the thermal fixing roller presses the heat resistant belt stretched between some supporting rollers, the nip is formed at the contacting part of the roller and the belt. Image fixing is operated at this nip area. A temperature sensor is installed in the nip area to detect the thermal fixing roller's surface temperature through the heat resistant belt.

0017
When fixing a color image, a large amount of unfixed toner has to be heated with a large amount of heat to achieve good coloration quality. Therefore, the belt nip method, on which a wide nip can be formed, is suitable. When the self striping method with thin paper, in other words, a method for decreasing adhesive power between the fixing roller and the melted toner, was being studied. The inventor discovered the following facts.

0018
The interface adhesive power between the melted toner and the fixing roller is not only affected by material property value based on surface chemistry of both the toner and the roller, but also by the fixing roller's surface deformation. If the melted toner is in contact with a fixing roller's surface which has already been deformed, the adhesive power between the toner and the fixing roller's surface is decreased rapidly from the moment the deformed surface's pressure is released.

0019
To be more concrete, the fixing roller's surface is covered with heat resistant elastic material, which can easily be deformed by the outside force, and which is made from, for example, silicon rubber or fluoric rubber. The fixing roller's surface is deformed by pressure of a hard roller installed near the nip exit, while toner image is being fixed. When the fixing roller's surface deformation is released at the nip exit, adhesive power between the fixing roller's surface and the toner is decreased. Then paper is separated from the roller by the paper's own strength. This fact is proved by the following model experiment.

<Model experiment> This model experiment proves the following fact. The surface deformation of the fixing roller affects the adhesive power between the toner and the roller.

0020

Fixing roller A (soft roller) covered with elastic material (Si rubber) 2.0 mm thick and the fixing roller B (hard roller) covered with 50 μm Teflon are both heated at 130℃. The paper surface, on which the image is copied with 3,0 mg/cm² color toner, is pressed against each fixing roller's surface with a pressure of X kg/ cm² during 10 seconds. The contacting surface of the toner is separated rapidly from the roller at 500mm/sec. Then the load for separating the surface is recorded by the load exchanger.

Diagram 3 shows the adhesive power detecting device and its outline. 16 is the adhesive part on the back of *copy paper 7.* 17 is a load transmission line. 18 is a load exchanger. 19 is a recorder.

Line chart 4 shows the results from this model experiment.

0021
As a result, in the case of fixing roller A, the separating load decreases as the pressing load increases. After the specific amount of pressing load is reached, the amount of separating load becomes 0. However, in the case of the fixing roller B (hard roller), the pressing load does not affect the separating load.

0022
When the soft roller's surface, coated with elastic material, is pressed, the surface is deformed. This deformed surface is in contact with the toner. When the pressure is released rapidly in this condition, deformed surface becomes the normal surface (surface without deformation). Micro slip occurs between the toner and the roller. This micro slip decreases the adhesive power.

With fixing roller B, which surface is not deformed, micro slip does not occurs. In other words, adhesive power is not decreased. This invention applied this fact to the belt nip typed fixing device.

0023
For achieving the fifth purpose above, the following fixing device is equipped with this invention: a fixing device, which fixes unfixed toner images on copying material with a thermal fixing roller, and which has the following structure.

- A thermal fixing roller, which is covered with elastic materials more than 0.5 mm thick.

- A heat resistant belt, which is stretched between several supporting rollers and the thermal fixing roller. In order to make a nip between the heat resistant belt and the fixing roller, part of the belt is pressed on the fixing roller from a specific angle.

- A pressure roller, which is installed under the heat resistant belt at the exit point of the nip.

Thanks to the pressure roller, which presses the thermal fixing roller through the heat resistant belt, the elastic material around the thermal fixing roller is deformed.

The thermal fixing roller can be the main drive. The heat resistant belt is driven by the roller.

0024
Inventors of this invention found the solution of achieving this fixing device, which provides clear images, by improving the following three points.

First point: With the conventional drive system, the belt, which is stretched between the rollers, is driven by the rollers. However, if the fixing roller acts as the main drive, a most accurate image can be achieved.

0025
The following are the three methods to drive the whole fixing device:
① Driving the fixing roller,
② Driving the endless belt,
③ Driving both the fixing roller and the endless belt.

Among these three methods, ① driving the fixing roller is the best way to achieve the most accurate image.

Second point: The endless belt's surface quality is regulated. Material for the endless belt was usually made of 75 μ m polyimide film or Teflon film with synthetic fiber. However, depending on surface characteristics, if friction coefficient with paper is smaller, image overlapping is less likely to occur. According to this, static friction coefficient μ should be less than 0.40, or more preferably less than 0.30, in order to prevent image overlapping. The back side of paper must preferably slide on the endless belt. On the other hand, the paper surface, which is in contact with the toner and the fixing roller, is regulated in order to stop sliding (static friction coefficient between the fixing roller and the paper is preferably more than 0.8).

Third Point: Silicon oil made from dimethylpolysiloxane has often been applied as a releasing agent. However with this invention, amino denatured silicon oil, which possesses amino group and which is excellent for soaking the endless belt is applied. The amino denatured silicon oil has to respect the following formula (1) and the adhesive power at 25℃ is 10～100,000cs.

[Note: See formula 1 on page 5 of the original text.]

0026
Number 2

0027
A stands for -R' -X (R' means alkylene group of 1 to 8 carbon number and X means $-NH_2$ or $-NH(CH_2)_2NH_2$ in this formula). *b* and *c* respectively stand for $0<b\leqq 10$ and $10\leqq c\leqq 1000$. The reason of the formula cannot be explained clearly. Amino group in amino denatured silicon oil works effectively to imide bond of the polyimide film, which is a basic film. Thanks to this, the method of soaking the polyimide film surface by oil is improved. Amino denatured silicon oil, which is provided along the fixing roller's surface, is applied on the polyimide film's surface. Thanks to this, paper's back side slides well on the endless belt, preventing image overlapping.

0028
For amino denatured silicon oil, A is suitable for $-(CH_2)_3NH_2$ or $-(CH_2)_3NH(CH_2)_2NH_2$. For its density, each b and c respect the formulae $0,01<b<1$ and $50\leqq c\leqq 300$. More preferable formulae for each b and c are $0,02\leqq b\leqq 0,5$ and $100\leqq c\leqq 200$. Oil adhesive power is suitable at 50～1000cs, and more preferably 100～400.

0029
Once toner is fixed with the use of this amino silicon oil, the toner image is not inferior even when copying on both sides of the paper. On the other hand, by using dimethylpolysiloxane, fixed toner image would become coarse. The difference happens because different chemical affinity from functional group influences mold releasing capability of the surface.

0030
These three points have their own effect but the problem of image overlapping is minimized with their combined use. The common idea of these three points is to deliberately slide paper's back side on the endless belt and to solve the problem of difference between the fixing roller's surface speed and the endless belt's surface speed.

0031
EMBODIMENT: Diagram 5 shows an example of belt nip method for achieving this invention.

EMBODIMENT 1: A soft roller, made of a metal core coated with elastic material, acts as a fixing roller.

An endless belt, which is stretched between several rollers, is pressed against a fixing roller (soft roller) to form a nip. A pressure roller, installed at the nip exit, presses the fixing roller through the endless belt. The fixing roller's surface is elastically deformed because of the pressure roller. To make sure the fixing roller's surface is efficiently deformed with a minimum load, the pressure roller's circumference must be smaller and its surface must be harder than the fixing roller's.

0032
Embodiment 1 explains the details of this invention. The fixing device described as embodiment 1 is shown in diagram 5. *Fixing roller 1* consists of *hollow roller 3*, which is made of a 46mm thick (outside diameter) and 40mm thick (inside diameter) aluminum hollow cylinder. *Roller 3* is coated with *base layer 20*, which is made of 2mm thick HTV silicon rubber (rubber hardness is 45 degrees). The *base layer 20*'s surface is dip-coated with *top coat 21*, which is made of 50 μ m thick silicon RTV rubber, and has a finish close to a mirror surface state. 40 W *halogen lamp 5* is installed inside of *fixing roller 1* as a heat source. The surface temperature of *fixing roller 1* is kept at 150℃ by a temperature controller (not shown in the diagram) via temperature *sensor 6*. For the mold-releasing agent, dimethylpolysiloxane oil of 300 cs adhesive power (KS-96: by Shin-Etsu Chemical Co., Ltd) is applied evenly from *oil applying system 9*.

Endless belt 15 is made from a 75 μ m thick, 300 mm wide and 288 mm long polyimide film. *Belt 15* is stretched over *stainless rollers 22, 23, 24, 25* with a 10 kg tension. Respective diameters of *rollers 22, 23, 24 and 25* are 22 cm, 20 cm, 20 cm and 18 cm. *Roller 25* (pressure roller) with a 18cm diameter is installed to press against *fixing roller 1* by *coil spring 26*, which is a pressure mean. The pressure angle of *fixing roller 1* is 45° . The belt nip is 19.6 mm wide. *Pressure roller 25* presses the belt nip exit through *belt 15*. Therefore, the elastic material of *fixing roller 1* is deformed. Drive force from *motor 27* is transmitted to *drive roller 22*. Then *belt 15* and *fixing roller 1* starts to rotate at 250 mm/sec in the direction of arrows shown in the diagram.

0033
Table 6 shows the result of paper's self stripping capability, when papers of different weight (thickness), on which fixed color toner with a 3.0 mg/cm^2 density is copied, are passed through this fixing device. In the paper conveying direction A, paper's fiber is placed in parallel with the fixing roller in order to be conveyed. In the paper conveying direction B, paper is conveyed in a perpendicular direction.

Papers conveyed in direction A are less easily self-stripped than the same papers conveyed in direction B. According to the above data, if the pressure roller's load is increased, lighter (thinner) papers separate by themselves more easily.

Comparable example: Here, the example of the other fixing roller (hard roller) is explained. Under the same condition as in embodiment 1, fixing roller A (soft roller) was exchanged with fixing roller B (hard roller), the latter being coated with 50 μ m thick Teflon. Then the self-stripping capability was studied. As a result, self-stripping could not be operated with the pressure roller, whatever the load.

Measuring deformation: The elastic material's surface deformation can be measured by the following method. When both load from the soft roller and the hard roller are pressed against each other, the soft roller's surface is deformed (deformation amount ε) at the nip area. Those rollers are rotated and then a sheet of paper passes through the nip area. The paper continues to be conveyed into the nip area, where it is deformed. When the paper is ejected, the length of paper conveyed by first rotation of the elastic roller is longer than the roller circumference by length deformation amount ε .

0034
Therefore, the following formula is respected.
ε ={(paper length when the paper is ejected by first rotation of the elastic roller) ÷ the roller circumference length when ε =0} −1.

With this formula, the deformation amount ε can be calculated. Line chart 8 shows the relation of load and deformation amount described in embodiment 1. With a deformation amount of 0.5 %, self-stripping of 90g/m^2 weight paper in the direction B can be achieved without problem. With a deformation amount of 2.5 %, self-stripping of thin paper (55g/ m^2) in the direction A (the most difficult condition) would be possible.

0035
Adhesive power of interface between the toner and the fixing roller is effectively decreased by releasing the surface deformation pressure at the nip area. This is adopted not only with the belt nip method, but also with the roll nip method. In this case, the fixing roller's surface hardness should be as soft as or softer than the pressure roller's. According to this, the fixing roller is deformed easily and self-stripping is operated smoothly.

Comparable example: With the same fixing device described in embodiment 1, the belt is removed and the other pressure roller is replaced to form a nip with the fixing roller (roll nip method). With this fixing device, the following text explains the relation between self-stripping and load.

0036
The pressure roller's diameter is as large as the fixing roller's (50mm). The pressure roller's surface is coated with 50 μ m Teflon. Both rollers' surface temperatures are kept at 160℃. Unfixed toner, in the same condition as described in embodiment 1, is inserted in the roll nip at 120mm/sec. Table 9 shows the result. Line chart 10 shows the relation between the fixing roller's load and the surface deformation. With the roll nip method, self-stripping with 90g/m^2 weight paper is obtained by a deformation amount of 1.0% towards direction B. With a deformation amount of 5%, self-stripping of thin paper (55g/m^2) towards direction A (the most difficult condition) becomes possible.

Page 7

Line chart 11 shows the results of the above experiments compared with the belt nip method of this invention.

0037
With the belt nip method, the roller is instantaneously deformed near the nip exit. Thanks to this, paper's self-stripping can be attained with smaller surface deformation than with using the roll nip method. Furthermore, even when the surface deformation is small, the rate of change is large. At the interface between the toner and the fixing roller, it is easy to obtain micro slip.

0038
With the belt nip method, total load required is only 10~20 kg but the roll nip method requires a total load greater than 80kg. In other words, the large amount of load can be reduced with the belt nip method. Thanks to this, drive torque of the surface cleaning device can be reduced. Lesser load means lesser rollers hardness; therefore, the roller's diameter and the roller's core may remain thin.

0039
With the conventional roll nip method, both rollers have to be separated in order to prevent the fixing roller's deformation when fixing is stopped. With this invention, the device could be simplified because there is no need to separate the rollers. The longer roller can also be equipped with this invention.

Generally, the rubber's heat transmitting rate is very low and rubber is suitable as a heat resistant material. To keep the temperature of the fixing roller stable, the rubber should rather be thin. With the conventional roll nip method, the fixing roller's rubber part must be thick and must have limited changing thickness when the wide nip area is used. With the belt nip method of this invention, the nip is formed by the belt and there is no need for thick rubber. The rubber thickness could be kept to the minimum thickness necessary to obtain deformation for self-stripping operation. With the belt nip method, nip width and deformation at the nip part can be changed separately.

0040
To be more concrete, with the conventional roll nip method, the elastic material's thickness is required to reach at least 2 mm, but for better results a 3 mm thickness is required. On the other hand, with this invention, the required elastic material's thickness is only 0.5 mm, or 1.0 mm for a better result. The remarkable features of this invention are: a controlled temperature with stability and a short warm up time.

With the conventional roll nip method, a separator is installed to prevent paper from twining around the pressure roller. With this invention, deformation rate can be enlarged at the paper separating point until paper stops to twine around the roller. Both fixing roller and belt do not require any separator. Thanks to this, problems with the conventional roll nip method, such as roller or belt damaged by the separator, and such as paper spots made by the release agent from the separator's edge, are solved.

EMBODIMENT 2: Formerly, there used to be a scratching problem because of the temperature sensor on the roller. This caused a fixing roller's shorter life or an inferior image quality. The damage was especially great for the elastic roller, which is coated with elastic material. With this invention, shown in diagram 12, the temperature sensor is installed under the belt. The fixing roller's temperature in the belt nip area is controlled by the temperature detected through the belt. Thanks to this, the problem of scratching by the sensor is solved completely.

EMBODIMENT 3: When a fixing experiment with this invention's belt nip typed fixing device was being studied, a new problem of image defect occurred because of the different amount of load from pressure roller. When the load of the pressure roller was increased and surpassed a specific amount, image started to be fixed with some overlapping (this does not happen when the belt nip method with the hard roller is applied in embodiment 1). Line chart 13 shows the result of studying the relation between the overlapping image and the load.

0041: The elastic roller's surface speed is affected by its deformation amount ε. When the elastic material's deformation amount ε, in the rotating direction, exists, the surface speed Vs respects the formula $Vs=(1+\varepsilon)V$. V is the surface speed when $\varepsilon=0$. With this invention's belt nip method, deformation amount ε in the rotating direction exists because of the load from the pressure roller at the nip exit area. Speed Vs at this nip exit area is slightly different from the speed V ($\varepsilon \fallingdotseq 0$) of the nip area formed only with the belt. If the difference of roller's surface speed exists in the belt nip area, paper attached on the roller's surface cannot absorb the speed difference over a specific amount. This causes the image overlapping. The deformation rate which allows interrupted continuous self-stripping and non overlapping image fixing is 0~3.75%.

Inventors found the following means to solve the overlapping image problem with the hypothesis described above.

0042
To minimize the image overlapping caused by the speed difference, *supporting pressure roller 29*, which is coated with soft elastic material, is installed upstream of the pressure roller in the belt circulating direction (shown in diagram 14). To prevent the fixing roller from sliding on the belt's surface, *supporting pressure roller 29* presses the belt onto the fixing roller's surface from under the belt.

In embodiment 2, an elastic roller is added to the fixing device described in embodiment 1. The elastic roller consists of a stainless core (6 mm diameter), which is coated with 6 mm thick Si rubber (23° rubber hardness degree / ASKER C typed hardness scale). The elastic roller is installed in order to press the fixing roller with 4 kg of load upstream (11 mm apart from the pressure roller) in the belt's circulating direction. As shown in table 15, it is possible to increase the load by up to 10 kg, by comparison of the load without *supporting pressure roller 29*. Self-stripping capability and fixing capability are also improved. By adopting the *supporting pressure roller*, even if the belt's elastic force is decreased, fixing strength does not change. Thanks to this, belt's life duration is long.

0043
To solve the problem of belt sliding, inventors studied a belt's stretching method and a roller's displacing method. The following are the facts learned from the study.

Diagram 16 explains the fact learned by the inventors. Diagram 16 shows three rollers used to stretch a belt.

First fact: The belt has to be stretched between at least three rollers. One of the rollers is *displacement roller 23* and the other two (or more) rollers would be *fixed rollers 24 and 25*. Belt nip is formed very efficiently between *fixed rollers*. When *displacement roller 23* is relocated across the axes of *fixed rollers 24 and 25*, the belt is forced to be twisted. According to this, belt is rippled upstream and downstream of *displacement roller 23* in the belt's rotating direction. However, this ripple is regulated by *fixed rollers 24 and 25* installed next to *displacement roller 23*. Thanks to parallelism of the two fixed rollers, most ripples on the surface of the belt, stretched between two *fixed rollers*, are prevented and the belt can keep a flat surface. By forming the belt nip on this flat surface, belt's ripples, wrinkles and damages are minimized. When a copy paper is inserted into this belt nip, paper's wrinkles and image trouble are also prevented.

0044

Second fact (displacement method of displacement roller's axis): When one end of the paper is displaced along an elliptical orbit, which is made by focal points of *fixed rollers 24 and 25*'s axes installed closely at both upstream and downstream sides of the displacement roller, belt stress is minimized. According to this, ripples, wrinkles and image trouble are also minimized. The displacement device could be small because the energy needed to displace the displacement roller is small. After the displacement's axis is relocated along *elliptical orbit 30*, belt's peripheral length does not change from the length effective before the displacement, in other words, belt's tension does not change during the interval between after and before the displacement.

0045

Diagram 17 shows a structure of belt sliding adjustment. When the belt slides to the right or left side, it obscures the light from *photo sensor 31*, which is installed at the belt's side edge, and then the belt sliding side is detected. For example in diagram 17, if the photo sensor detects that the belt slides towards the front side, signals are sent to *pulse motor 32. Pulse motor 32* is rotated by a specific length to displace the axis, which is placed in front of the displacement roller, in the direction D. *Guide 33* is installed to relocate the axes of the displacement roller along the ellipse orbit. Then the belt slides towards the other direction from the front side and the belt position is adjusted.

EMBODIMENT 4: Fixing roller 1 (soft roller) consists of a metallic core, which surface is coated with elastic material. To be more precise, 46 mm thick (external diameter) and 40mm thick (internal diameter) *aluminum hollow roller 3* is coated with 2 mm thick *HTV silicon rubber 20* (rubber hardness is 45 degrees). *HTV silicon rubber 20*'s surface is top-coated with 50 μ m thick *silicon RTV rubber 21*. The surface has a finish close to a mirror surface state. 40 W *Halogen lamp 5* is installed inside of *fixing roller 1* as a heat source. The surface temperature of *fixing roller 1* is detected by *temperature sensor 6* and then kept at 150℃ by temperature controller (not shown in the diagram).

0046

For the mold releasing agent, amino denatured silicon oil of 300cs oil adhesive power (by Shin-Etsu Chemical Co., Ltd), b=0,1 and c=130 (X-21-7763G) is applied evenly from *oil applying system 9.* The amino denatured silicon oil has a functional group of $-(CH_2)_3NH_2$.

Endless belt 15 is made of 75 μ m thick polyimide film, with a static friction coefficient of 0.40, 300 mm wide and 288 mm long. *Belt 15* is stretched over four stainless rollers respectively 22 cm, 20 cm, 20 cm and 18 cm in diameter. *Coil spring 26*, which is a pressure mean, presses 18cm diameter *roller 25* (pressure roller) towards *fixing roller 1*'s center through the belt, with a total load of 25 kg. The pressing angle of *fixing roller 1* is 45° . The belt nip is 19.6 mm wide. *Pressure roller 25* presses the belt nip exit through *belt 15*; therefore, the elastic material of *fixing roller 1* is deformed. Drive force from *motor 27* is transmitted to *fixing roller 1.* In accordance with *fixing roller 1, belt 15* rotates at 200~350 mm/sec in the direction of arrow 28 shown in the diagram.

0047

With this fixing device, various A4 sized papers, on which unfixed solid image is copied with 2.5 mg/cm² density color toner, are fixed at speed of 250 mm/sec~350 mm/sec. 20 continuous fixing operations (in order to test the condition where oil supply for each sheet of paper cannot keep up with the high speed) are executed with various setting temperatures of 150℃, 165℃ or 180℃. Based on this experiment, image overlapping problems can be studied under the various conditions.

0048

Table 1

Fixing speed	Paper weight 55g/m²	64g/m²	Both coated side 100g/m²
250mm/sec	○	○	○
300mm/sec	○	○	○
350mm/sec	○	○	○

○: no problem
△: slight overlapping (maximum allowed level)
×: image overlapping (beyond the maximum allowed level)

0049
EMBODIMENT 5: For the release agent, the amino denatured silicon oil (by Shin-Etsu Chemical Co., Ltd X-21-7720), which amino group is – $(CH_2)_3NH$ $(CH_2)_2NH_2$, is set under the same condition as in embodiment 4. With these additional conditions, the same experiment as embodiment 4 is studied but the result is the same as in embodiment 4.

EMBODIMENT 6: For the release agent, dymethylpolysiloxane oil (by Shin-Etsu Chemical Co., Ltd, KT-96, 360cs), which does not contain the amino group, is set under the same condition as embodiment 4 and 5. Image overlapping problem occurs due to high speed in the last half of continuous fixing operation as shown in table 2.

0050
Table 2

Fixing speed	Paper weight 55g/m²	64g/m²	Both coated side 100g/m²
250mm/sec	○	○	○
300mm/sec	○	○	○
350mm/sec	△	△	△

○: no problem
△: slight overlapping (maximum allowed level)
×: image overlapping (beyond the maximum allowed level)

0051
EMBODIMENT 7: The amino denatured silicon oil (by Shin-Etsu Chemical Co., Ltd., b=0.1, c=130, X-21-7763G), which functional group is – $(CH_2)_3NH_2$, is applied as the release agent. Additionally static friction coefficient of polyimide endless film is set at 0.5. With these additional conditions, the same experiment as embodiment 4 is studied but the result is the same as in embodiment 4.

EMBODIMENT 8: The amino denatured silicon oil (by Shin-Etsu Chemical Co., Ltd X-21-7720), which amino group is – $(CH_2)_3NH$ $(CH_2)_2NH_2$, is applied as the releasing agent. Additionally static friction coefficient of endless belt is set at 0.5, as described in embodiment 7. The same experiment as embodiment 7 is studied but the result is the same as in embodiment 7.

Comparative example 3: Dymethylpolysiloxane oil (by Shin-Etsu Chemical Co., Ltd, KF-96, 300cs) is applied for the release agent as done with the conventional use and then the same experiment as embodiment 7 and 8 is studied. As the result in table 3 shows, image overlapping problem occurs more and more frequently at high speeds on the last 15 ~ 20th sheets of paper with continuous fixing operation. The inventors conclude that the result is due to the oil's soaking type and affinity against the polyimide film. In other words, amino group has more affinity against imide group of polyimide film than methyl group. Even when the applied oil becomes insufficient because of the continuous operation, amino group is more adhesive than imide group.

0052
Table 3

Fixing speed	Paper weight 55g/m²	64g/m²	Both coated side 100g/m²
250mm/sec	○	○	△
300mm/sec	△	△	×
350mm/sec	×	×	×

○: no problem
△: slight overlapping (maximum allowed level)
×: image overlapping (beyond the maximum allowed level)

0053
EMBODIMENT 9: The surface static friction coefficient of the endless belt is set to 0.30. But besides that, the experiment is studied under the same condition as embodiment 4. For detecting the static friction coefficient, surface determination device, HEIDON-14 model by Shinkyo Chemical Co., LTD, is used. Moreover, this static friction coefficient (normal force of 200g) is detected with L paper (64g/m², by Fuji Xerox Co., Ltd). The result is excellent without any image overlapping and is better than the result of embodiment 4. The result is shown in table 4.

0054
Table 4

Fixing speed	Paper weight 55g/m²	64g/m²	Both coated side 100g/m²
250mm/sec	○	○	○
300mm/sec	○	○	○
350mm/sec	○	○	○

○: no problem
△: slight overlapping (maximum allowed level)
×: image overlapping (beyond the maximum allowed level)

0055
Comparable example: As with embodiment 9, the endless belt's surface static friction coefficient is set at 0.30. And dymethylpolysiloxane oil, which does not possess a functional group, is applied as a releasing agent. The result of the experiment is shown in table 5. There is a tendency of image overlapping problem at high speed continuous operation, but it remains under acceptable level.

0056
Table 5

Fixing speed	Paper weight 55g/m²	64g/m²	Both coated side 100g/m²
250mm/sec	○	○	○
300mm/sec	○	○	○
350mm/sec	○	○	△

○: no problem
△: slight overlapping (maximum allowed level)
×: image overlapping (beyond the maximum allowed level)

0057
Comparable example 5: As with embodiment 6, the endless belt's surface static friction coefficient is set at 0.40. For driving the fixing device, the following three methods are studied:
① Only fixing roller 1 is driven by motor 27 and, according to the fixing drive, other rollers follow.
② Roller 22, which stretches the endless belt, is driven by motor 28 (not shown in diagram). The endless belt rotates with roller 22. Then the fixing roller is driven in accordance with roller 22 and the endless belt.
③ Both methods ① and ② above are applied at the same time.

The result is shown in table 6.

0058
Table 6

\ Driving method / Fixing \ paper's Speed \ weight	① Driving the fixing roller 55g/m²	64g/m²	Both coated side 100g/m²
250mm/sec	○	○	○

300mm/sec	○	○	○
350mm/sec	△	△	△

＼ Driving method	② Driving the endless belt		
Fixing ＼ paper's Speed ＼ weight	55g/m²	64g/m²	Both coated side 100g/m²
250mm/sec	△	△	△
300mm/sec	×	×	×
350mm/sec	×	×	×

＼ Driving method	③ Driving both rollers		
Fixing ＼ paper's Speed ＼ weight	55g/m²	64g/m²	Both coated side 100g/m²
250mm/sec	○	○	○
300mm/sec	△	△	△
350mm/sec	×	×	×

○: no problem
△: slight overlapping (maximum allowed level)
×: image overlapping (beyond the maximum allowed level)

0059
Driving only the fixing roller is the most effective driving method for avoiding image overlapping problem with the fixing device.

0060
EFFECT OF THE INVENTION
With the conventional belt nip typed fixing device, the pressure roller presses the fixing roller through the belt at the belt nip area to deform the fixing roller's surface. According to this, paper can be separated with a self-stripping method. This invention's fixing device could be applied not only to a black and white image fixing device but also to a color image fixing device.

Problems that occur with the conventional belt nip method, such as belt's ripples, wrinkles and damages, are minimized by adopting new methods to stretch the belt and by adopting the structure for correcting the belt's slide. Thanks to this, the belt lasts much longer than before. Paper's wrinkles and image fixing problem are also prevented. This invention's belt nip typed fixing device has better advantages, such as high speed operation, reliable performance and excellent image quality, than the roll nip typed fixing device. This fixing device's industrial utility value is very high.

0061
Furthermore, this invention solves the problem of scratches made by the separator, which happen with the conventional belt nip method. Also, high image quality without image overlapping is achieved under any condition, such as high speed operation, continuous operation and different types of paper. The belt nip typed fixing device of this invention has better advantages, such as high speed operation, reliable performance and excellent image quality, than the roll nip typed fixing device, which is equipped with 11 pairs of rollers. This fixing device's industrial utility value is very high.

BRIEF DESCRIPTION OF DIAGRAMS
Diagram 1: Conventional roll nip typed fixing device
Diagram 2: Conventional belt nip typed fixing device
Diagram 3: Adhesive power detecting device, which detects toner's adhesive power against the fixing roller
Line chart 4: The result of model experiment to study the difference between using a soft roller and a hard roller as the fixing roller
Diagram 5: Belt nip typed fixing device described in embodiment 1
Table 6: Self-stripping capability with a soft roller applied to this invention
Table 7: Self-stripping capability with a conventional hard roller as a comparable example
Line chart 8: The fixing roller's surface deformation with the belt nip typed fixing device described in this invention's embodiment
Table 9: Self-stripping capability with a conventional belt nip typed fixing device as a comparable example

Line chart 10: The fixing roller's surface deformation with the conventional roll nip typed fixing device as a comparable example
Line chart 11: Differential of separable deformation amount between this invention's belt nip typed fixing device and the conventional roll nip typed fixing device.

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Diagram 12: This invention's belt nip typed fixing device shown in diagram 5, which equips the temperature sensor under the belt
Table 13: The relation of the pressure roller's load and image overlapping by the belt nip typed fixing device shown in diagram 5
Diagram 14: This invention's belt nip typed fixing device described in embodiment 3
Table 15: he relation of the pressure roller's load and image overlapping by the belt nip typed fixing device shown in diagram 14
Diagram 16: Belt slide correcting structure equipped in this invention's belt nip typed fixing device
Diagram 17: Close up diagram of belt slide correcting structure used in this invention's belt nip typed fixing device
Diagram 18: This invention's belt nip typed fixing device, where the fixing device is the main drive and the endless belt rotates in accordance with the roller

DESCRIPTION OF NUMBERS
1 Fixing roller
2 Pressure roller
3 Hollow roller
4 Teflon coat
5 Halogen lamp
6 Temperature sensor
7 Copy paper
8 Unfixed toner
9 Oil supplying device
10 Metal core roller
11 Heat resistant elastic material
12 Separator
13, 14 Supporting rollers
15 Endless belt
16 Adhesive part of copy paper's back
17 Load transmitting part
18 Load exchanger
19 Recorder
20 Base coat
21 Top coat layer
22, 23, 24 Supporting rollers
25 Pressure roller
26 Compressed coil spring
27 Motor
29 Supporting pressure roller
30 Elliptical orbit
31 Photo sensor
32 Pulse motor
33 Guide

21

トの内側に温度センサを配置した本発明の第２実施例を示す概略図である。

【図１３】図５のベルトニップ式定着装置における圧力ロールの荷重と画像ずれとの関係を表を用いて示す図である。

【図１４】本発明の第３実施例によるベルトニップ式定着装置を示す概略図である。

【図１５】図１４のベルトニップ式定着装置における圧力ロールの荷重と画像ずれとの関係を表を用いて示す図である。

【図１６】ベルト補正機構を組み込んだ本発明のベルトニップ式定着装置を示す概略図である。

【図１７】本発明のベルトニップ式定着装置に組み込まれたベルト補正機構を示す拡大図である。

【図１８】定着ロールを駆動としエンドレスベルトを従動とした本発明のベルトニップ式定着装置を示す概略図である。

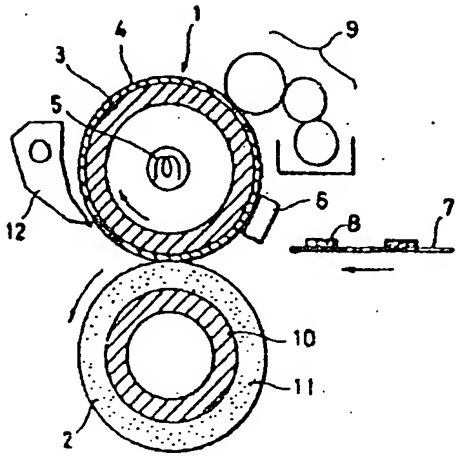
【符号の説明】

1　定着ロール
2　加圧ロール
3　中空ロール
4　テフロン被覆層
5　ハロゲンランプ
6　温度センサ

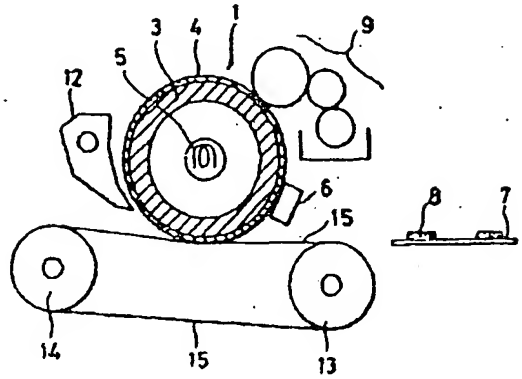
22

7　記録紙
8　未定着トナー
9　オイル供給装置
１０　芯金ロール
１１　耐熱弾性体
１２　剥離爪
１３、１４　支持ロール
１５　エンドレスベルト
１６　記録紙背面接着部分
１７　荷重伝達棒
１８　荷重変換器
１９　記録計
２０　下地層
２１　トップコート層
２２、２３、２４　支持ロール
２５　圧力ロール
２６　圧縮コイルスプリング
２７　モータ
２９　圧力補助ロール
３０　楕円軌道
３１　フォトセンサ
３２　パルスモータ
３３　ガイド

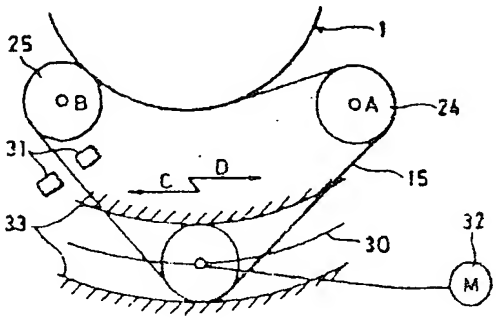
【図１】



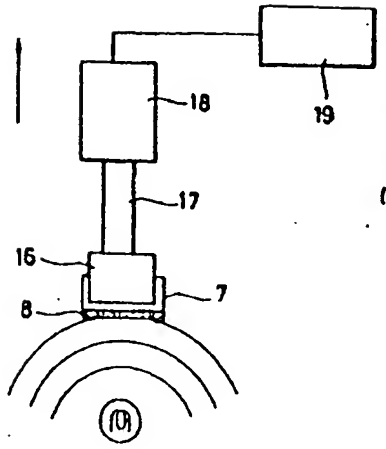
【図２】



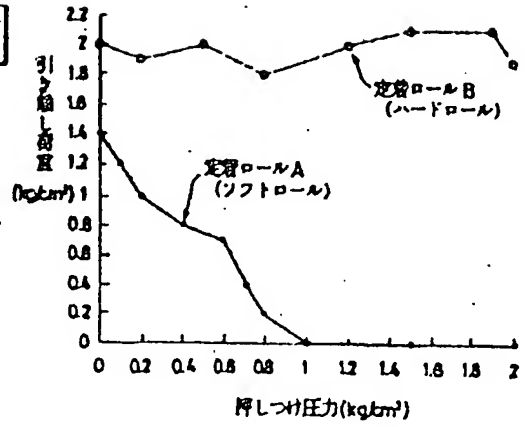
【図１７】



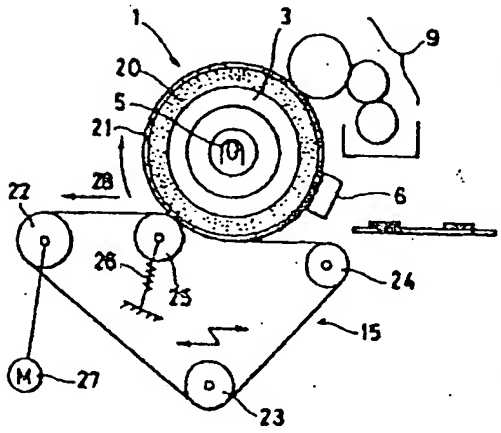
【図3】



【図4】



【図5】



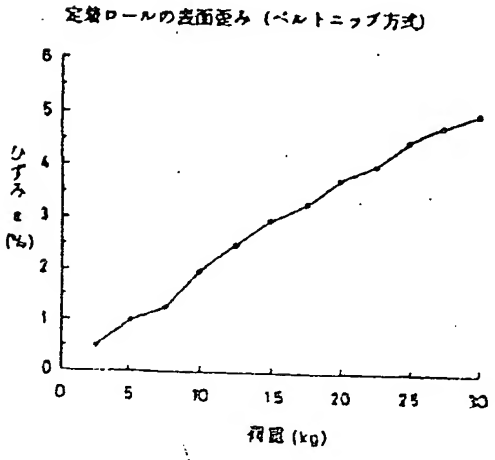
【図6】

ソフトロールのセルフストリッピング性

紙の重量 / 送り方向 / 圧力ロール荷重(kg)	55g/m²		65g/m²		90g/m²	
	A	B	A	B	A	B
0	×	×	×	×	×	×
2.5	×	×	×	○	×	○
5.0	×	×	×	○	×	○
7.5	×	○	×	○	×	○
10.0	×	○	×	○	○	○
12.5	×	○	○	○	○	○
15.0	○	○	○	○	○	○
17.5	○	○	○	○	○	○
20.0	○	○	○	○	○	○

○：セルフストリッピング可能
×：セルフストリッピング不可

【図8】



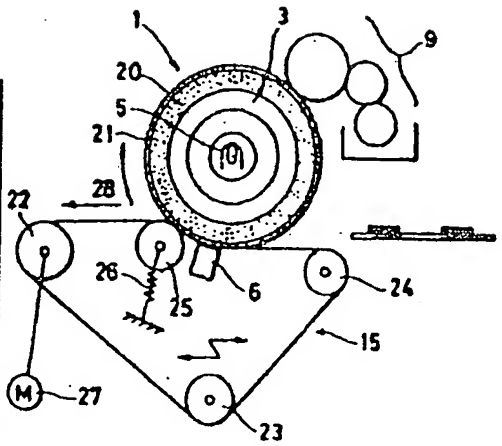
【図7】

ハードロールのセルフストリッピング性

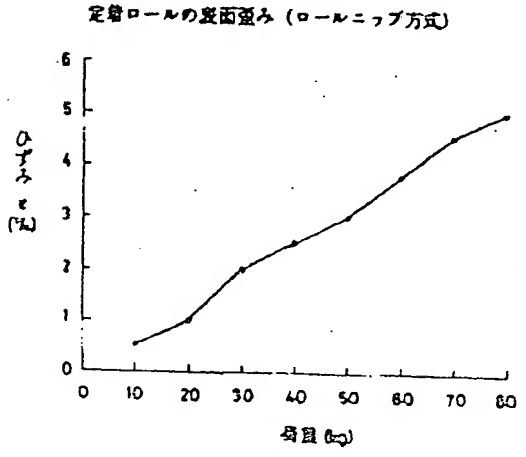
圧力 ロール荷重(kg) ＼ 紙の坪量 55g/m² 65g/m² 90g/m² ＼ 送り方向	55g/m² A	55g/m² B	65g/m² A	65g/m² B	90g/m² A	90g/m² B
0	×	×	×	×	×	×
2.5	×	×	×	×	×	×
5.0	×	×	×	×	×	×
7.5	×	×	×	×	×	×
10.0	×	×	×	×	×	×
12.5	×	×	×	×	×	×
15.0	×	×	×	×	×	×
17.5	×	×	×	×	×	×
20.0	×	×	×	×	×	×

○: セルフストリッピング可能
×: セルフストリッピング不可

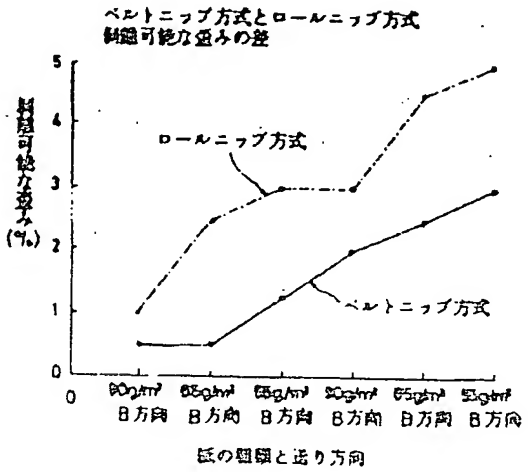
【図12】



【図10】



【図11】



【図9】

ロールニップ方式のセルフストリッピング性

紙の種量 / 送り方向 / 圧力ロール荷重(kg)	55g/m²		65g/m²		90g/m²	
	A	B	A	B	A	B
0	定着せず					
10	定着せず					
20	×	×	×	×	×	×
30	×	×	×	×	×	○
40	×	×	×	○	○	○
50	×	○	×	○	○	○
60	×	○	×	○	○	○
70	×	○	○	○	○	○
80	○	○	○	○	○	○

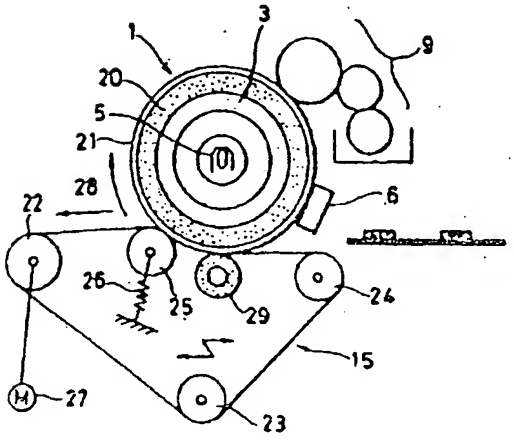
○: セルフストリッピング可能
×: セルフストリッピング不可

【図13】

圧力ロールの荷重(kg)	画像ずれの有無
0	○
5	○
10	○
15	○
20	○
25	×
30	×

○: 画像ずれ無
×: 画像ずれ有

【図14】



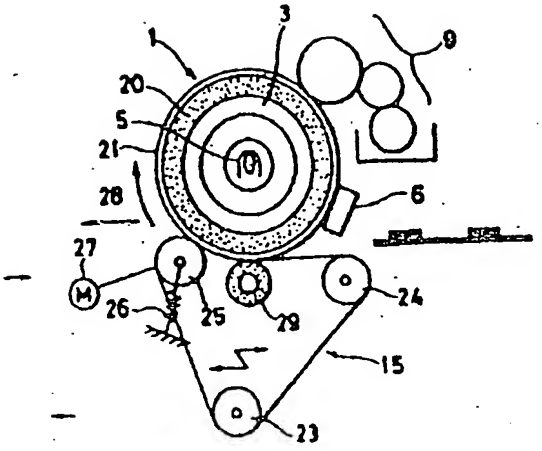
【図15】

画像ずれと荷重の関係

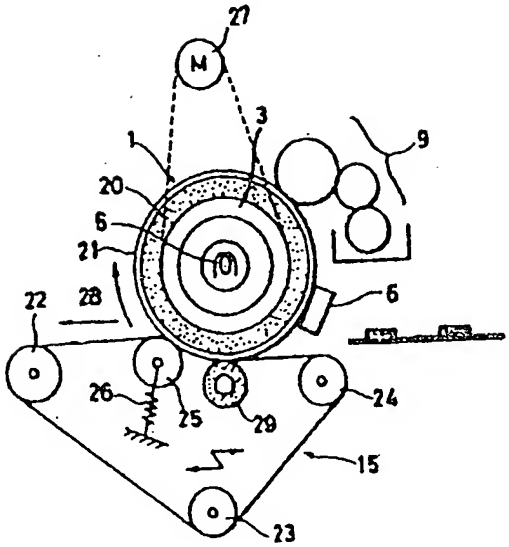
圧力ロールの荷重(kg)	画像ずれの有無	
	圧力補助ロール無	圧力補助ロール有
0	○	○
5	○	○
10	○	○
15	○	○
20	○	○
25	×	○
30	×	○

○: 画像ずれ無
×: 画像ずれ有

【図16】


1
3
9
20
5
21
101
6
28
27
M
26
25
29
24
15
23

【図18】


27
M
3
1
9
20
5
21
101
6
22
28
26
25
29
24
15
23